BRITISH MUSEUM
(NATURAL HISTORY)
- 3 DEC 1992
PRESENTED
GENERAL LIBRARY

Bulletin British Museum (Natural History)

Botany Series

VOLUME 22 NUMBER 2 26 NOVEMBER 1992

SHOUT
SHARE
IT

The *Bulletin of the British Museum (Natural History)*, instituted in 1949, is issued in four scientific series, Botany, Entomology, Geology (incorporating Mineralogy) and Zoology.

The Botany Series is edited in the Museum's Department of Botany

Keeper of Botany:	Dr S. Blackmore
Editor of Bulletin:	Dr R. Huxley
Assistant Editor:	Mrs M.J. West

Papers in the *Bulletin* are primarily the results of research carried out on the unique and ever-growing collections of the Museum, both by the scientific staff and by specialists from elsewhere who make use of the Museum's resources. Many of the papers are works of reference that will remain indispensable for years to come.

A volume contains about 160 pages, made up by two numbers published Spring and Autumn. Subscriptions may be placed for one or more of the series on an annual basis. Individual numbers and back numbers can be purchased and a Bulletin catalogue, by series, is available. Orders and enquiries should be sent to:

Intercept Ltd.
P.O. Box 716
Andover
Hampshire SP10 1YG

Telephone: (0264) 334748
Fax: (0264) 334058

World List abbreviation: *Bull. Br. Mus. nat. Hist.* (Bot.)

© British Museum (Natural History), 1992

ISSN 0068–2292

British Museum (Natural History)
Cromwell Road
London SW7 5BD

Typeset by Ann Buchan (Typesetters), Middlesex
Printed in Great Britain by The Alden Press, Oxford

Botany Series
Vol. 22, No. 2, pp. 109–170

Issued 26 November 1992

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 109–121 Issued 26 November 1992

Palynological evidence for the generic delimitation of Sechium (Cucurbitaceae) and its allies

BRITISH MUSEUM (NATURAL HISTORY)
- 3 DEC 1992
PRESENTED
GENERAL LIBRARY

JOSE LUIS ALVARADO
Instituto Nacional de Antropología e Historia, Mexico

RAFAEL LIRA-SAADE
Herbario Nacional de México, Instituto de Biología, U.N.A.M. Mexico

JAVIER CABALLERO
Jardín Botánico, Instituto de Biología, U.N.A.M. Mexico

CONTENTS

Introduction 109
Material and Methods 110
Results and Discussion 112
1. Pollen Morphology 112
2. Numerical Taxonomic Treatment 119
Conclusions 120
Acknowledgements 121
References 121

SYNOPSIS. In order to gather new data about the taxonomic limits of *Sechium*, a palynological study of 15 taxa belonging to the genera *Sechium* sensu lato, *Frantzia*, *Parasicyos*, *Michrosechium*, *Pterosicyos*, *Sechiopsis* and *Sicyos*, all in subtribe Sicyinae, was carried out. A numerical taxonomic analysis was conducted using the palynological characters observed. The results obtained showed that pollen morphology is highly significant in the delimitation of genera within the subtribe Sicyinae, and give some support to the conclusions of Jeffrey (1978) that genera *Ahzolia Polakowskia* and *Frantzia*, as well as *Microsechium hintonii* are congeneric with *Sechium*.

INTRODUCTION

According to Jeffrey (1990), the genus *Sechium* P.Br. belongs to the subtribe Sicyinae C. Jeffrey, tribe Sicyeae Schrad. For a long time this genus was considered as monospecific, consisting only of *S. edule* (Jacq.) Swartz, a highly variable crop species native to Mexico and Central America. Based upon the comparison of macromorphological characters, Jeffrey (1978) enlarged the limits of *Sechium* by including in two sections a series of Mexican and Central American species formerly pertaining to the genera *Ahzolia*, *Microsechium*, *Polakowskia* and *Frantzia* (Dieterle, -F7 1976; Pittier, 1910; Wilson, 1958; Wunderlin, 1976; Table 1). However, this circumscription of the genus has not been widely accepted. In a study on the origin and evolution of *Sechium edule*, Newstrom (1986, 1990) proposed the segregation of *Sechium* sensu stricto (constituted by three species) and the reinstatement of the genera *Frantzia* and *Polakowskia* (Table 1), mainly on the basis of the comparison of flower and fruit characters.

The controversy described above remains unsolved and

Table 1 Summary of the two generic conceptions of *Sechium* and its closest allies.

Jeffrey (1978, 1990)	Newstrom (1986, 1990)
Sechium P.Br. (*s. l.*)	*Sechium* P.Br. (*s. str.*)
Section *Sechium* ('pouch-like' nectaries)	No sections
S. edule (Jacq.) Swartz	*S. edule* (Jacq.) Swartz
S. compositum (Donn. Sm.) C. Jeffrey	*S. compositum* (Donn. Sm.) C. Jeffrey
S. hintonii (P.G. Wilson) C. Jeffrey	*S. hintonii* (P.G. Wilson) C. Jeffrey
	Polakowskia Pittier
S. tacaco (Pitt.) C. Jeffrey	*P. tacaco* Pitt.
S. talamancense (Wunderlin) C. Jeffrey	*P. talamancensis* (Wunderlin) Newstrom
Section *Frantzia* ('cushion-like' nectaries	*Frantzia* Pittier
S. pittieri (Cogn.) C. Jeffrey	*F. pittieri* (Cogn.) Pitt.
S. villosum (Wunderlin) C. Jeffrey	*F. villosa* Wunderlin
	F. venosa L.D. Gómez
	F. panamensis Wunderlin

more comparative evidence is still needed in order to assess the generic limits of *Sechium*. Related to this, several palynological studies (Ayala-Nieto et al ., 1988; Jeffrey, 1964, 1980; Page & Jeffrey, 1975; Singh & Singh, 1990) have shown that pollen morphology varies considerably between taxa within the Cucurbitaceae and that this kind of character could be highly significant in the delimitation of tribes, subtribes and even genera. Following this approach, the authors conducted a palynological study of the species of *Sechium* sensu lato (Cucurbitaceae) and its allies in order to provide some empirical evidence for the taxonomic delimitation of the genus *Sechium*. This study included the description of the morphological characters of the pollen grains of 15 different taxa of *Sechium* and their relatives, as well as the utilization of such characters to assess the generic limits of *Sechium* by means of a numerical taxonomic analysis.

The 15 taxa studied include: the seven species recognized by Jeffrey (1978, 1990) as constituting *Sechium* sensu lato (wild and cultivated forms of *S. edule* were considered as different taxa for the purpose of the study); two species of *Frantzia* not yet transferred to *Sechium* (*F. panamensis* Wunderlin and *F. venosa* L.D. Gómez) (Gómez & Gómez, 1984; Wunderlin, 1977); and five other species each one belonging to a distinct genus of the subtribe Sicyinae (*Microsechium helleri* (Peyr.) Cogn., *Parasicyos maculatus* Dieterle, *Sechiopsis triquetra* (Ser.) Naudin, *Pterosicyos laciniatus* Brandegee, and *Sicyos motozintlensis* Lott & Fryxell).

Of the 15 taxa included in this study only *Microsechium helleri* (Rodríguez-Jiménez & Palacios-Chávez, 1991), *Sechium compositum* (Dieterle, 1976; Marticorena, 1963 as *Ahzolia composita*), *S. pittieri* and *S. tacaco* (Marticorena, 1963 as *Frantzia pittieri* and *Polakowskia tacaco* respectively) have been palynologically studied before. As for *Sechium edule*, only the pollen grains of cultivated plants have been previously described (Aleshina, 1964; Ayala-Nieto et al., 1988; Erdtman, 1952; Marticorena, 1963; Rangaswami, 1976; Singh & Singh, 1990), therefore this study included the examination of pollen from wild populations.

MATERIALS AND METHODS

Pollen samples of the 15 taxa of *Sechium* and their relatives were taken from herbarium specimens (Table 2) available at the following institutions: Colegio de Postgraduados, Chapingo, Mexico (CHAPA); Herbario Nacional de México, U.N.A.M.(MEXU); Instituto de Ecología, Xalapa, Mexico (XAL); British Museum (Natural History) (BM); Gray Herbarium, Harvard University (GH); Royal Botanic Gardens, Kew (K); University of Michigan (MICH); and Missouri Botanical Garden (MO).

The samples were examined by light microscope (LM). Anthers, flowers and small buds were removed from the specimens and then acetolized according to the method described by Erdtman (1943). Permanent slides were made using glycerine jelly. Two slides were made from each specimen examined (Table 2). Measurements of the 12 palynological characters considered in this study (Table 3) were made from 10 pollen grains in polar view and 10 pollen grains in equatorial view from each slide. Microphotographs of the pollen grains were made using a LEITZ-DIALUX microscope under 40 × objective, and 100 × oil immersion objective. These microphotographs were made using Kodak Plus-X film. In order to obtain additional information on the pollen morphology of the taxa under study, samples of some of them were also examined under Scanning Electron Microscope (SEM; JEOL-SM) and photographed (3000 X). The slides are deposited in the Pollen Collections of the Laboratorio de Paleobotánica of the Instituto Nacional de Antropología e Historia, Mexico, and the Herbario Nacional de México, U.N.A.M. (MEXU). The terminology followed in the description of pollen grains is that of Erdtman (1952), Faegri & Iversen (1964) and Kremp (1965).

The numerical taxonomic analysis of *Sechium* sensu lato and its relatives made use of two complementary methods: cluster analysis and ordination techniques. These techniques were used to investigate the grouping of taxa within the genus, on the basis of their overall palynological similarity. Both cluster analysis and ordination techniques were applied using the 'Numerical Taxonomy and Multivariate Analysis System' (NTSYS-PC version 1.50; Rohlf 1989). Twelve palynological characters were included in the analysis. In addition, two floral characters (nectary and stamen structure) were used, both being features of great significance to the classification of the genera of the subtribe Sicyinae, and to the separation of the sections of *Sechium* sensu lato (Jeffrey, 1978, 1990). The characters used included both metric and non-metric characters (Table 3).

A basic data matrix (BDM) was formed with the different character average values for each species. Since characters 8 to 14 are non-metric (see Table 3), their values in the BDM do not constitute averages, but represent codes for the character states observed in each species. In all the species studied, the states of the seven qualitative characters were uniform for all the specimens examined. The result was a 15 × 14 matrix in which rows were Operational Taxonomic Units (OTUs) and columns were characters. This BDM is shown in Table 4 in which OTUs are presented as rows and characters are presented as columns. To reduce the effects of different measure scales in different characters and to make the characters contribute more equally to similarity, the BDM was standardized by rows using the linear transformation algorithm provided by NTSYS (Rohlf, 1989: 6.89). The subtract option used in the standardization was the mean of each variable and the divide option was the standard deviation.

For the cluster analysis, a dissimilarity matrix of distances between OTUs was calculated from the BDM standardized using the Average Taxonomic Distance Coefficient (see Rohlf, 1989: 6.13). This coefficient is a variation of the widely known Euclidian Distance Coefficient (see Dunn and Everitt, 1982: 32; Rohlf, :6.13; Romesburg, 1984: 12). A cluster analysis using the unweighted pair-group method (UPGMA), as described by Romesburg (1984: 15), was carried out using the above dissimilarity matrix. The ordination of the 15 OTUs in a multidimensional space of characters was made by means of a Principal Coordinate Analysis (PCO). This method was used instead of Principal Components Analysis or other similar metric technique the characters used included qualitative characters. PCO is an extension of Principal Component Analysis which allows the utilization of qualitative or mixed data (see Rohlf, 1989: 6.25 and 8.3). PCO was run in two directions: by columns to obtain the representation of the OTUs in a multidimensional space of characters; and by rows, in order to identify those characters which contribute the most to clustering. In the case of the analysis by

Table 2 List of voucher specimens of the 15 taxa included in the palynological study.

	SECHIUM S. L.			
1. *S. compositum*	Chiapas	Breedlove	31625	MEXU
	Chiapas	Breedlove	55725	MEXU
	Chiapas	Heath & Long	577	MEXU
	Chiapas	Lira	950	MEXU
	Chiapas	Lira	952	MEXU, K
	Chiapas	Lira	960	MEXU, K
	Chiaqpas	Matuda	2151	MEXU
	Chiapas	Matuda	17047	MEXU
	Guatemala	Lira	1004	MEXU, K
2. *S. edule* (wild=w)	Veracruz	Beristain	2247 (w)	CHAPA
	Veracruz	Beristain	2248 (w)	CHAPA
3. *S. edule* (cultivated=c)	Veracruz	Beristain	2250 (w)	CHAPA
	Veracruz	Beristain	2251(w)	CHAPA
	Veracruz	Beristain	2252 (w)	CHAPA
	Veracruz	Beristain	2253 (w)	CHAPA
	Veracruz	Beristain	2254 (w)	CHAPA
	Veracruz	Beristain	2257 (w)	CHAPA
	Veracruz	Cruz-Léon	2211 (w)	CHAPA
	Veracruz	Lira	1029 (w)	MEXU
	Yucatán	Lira	507 (c)	MEXU
	Campeche	Lira	807 (c)	MEXU
	Hidalgo	Villa	72 (c)	XAL
4. *S. hintonii*				
	Edo. de México	Hinton	4808	GH
	Edo. de México	Lira & Soto	1082	MEXU, K
5. *S. pittieri*	Costa Rica	Chacón	397	MEXU
	Costa Rica	Garwood	423	BM
	Costa Rica	Grayum	8103	BM
	Costa Rica	Khan	1020	BM
	Panamá	Hampshire	676	BM
	Panamá	Mori	5636	MEXU
	Panamá	Schmalzel	1942	BM
6. *S. tacaco*	Costa Rica	Lira	1062	MEXU, K
	Costa Rica	Lira	1064	MEXU, K
	Costa Rica	Raven	21793	MO
7. *S. talamancense*	Costa Rica	Grayum	8159	BM
	Costa Rica	Lira	1055	MEXU, K
8. *S. villosum*	Costa Rica	Skutch	3163	GH
	FRANTZIA			
9. *F. panamensis*	Panamá	Antonio	2687	MO
10. *F. venosa*	Costa Rica	Gómez	20483	MO
	Costa Rica	Lira	1036	MEXU, K
	PARASICYOS			
11. *P. maculatus*	Guatemala	Williams	40205	MIDH
	MICROSECHIUM			
12. *M. helleri*	Edo. de México	Lira	1077	MEXU, K
	PTEROSICYOS			
13. *P. laciniatus*	Chiapas	Lira	956-A	MEXU, K
	SECHIOPSIS			
14. *S. triquetra*	Guerrero	Lira & Soto	1087	MEXU, K
	SICYOS			
15. *S. motozintlensis*	Chiapas	Lira	951	MEXU, K

Table 3 List of the palynological characters (1–12) and the floral ones (13, 14) used in the numerical taxonomic study of *Sechium s. l.* and its allies.

1. Polar axis (μm)
2. Equatorial axis (μm)
3. Spine length (μm)
4. Exine thickness (μm)
5. Number of colpi
6. Polar/Equatorial Ratio
7. Polar area Index
8. Ornamentation type
   0 = spiniferous, microreticulate
   1 = spiniferous, clavate, microreticulate
   2 = spiniferous, reticulate
9. Shape
   0 = oblate
   1 = suboblate
   2 = oblate-spheroidal
10. Spine type
    0 = conic, short ($\bar{x}$ length < 4.5 μm)
    1 = conic, long ($\bar{x}$ length > 4.5 μm)
    2 = cylindric, very variable length
11. Spines apex
    0 = without a small cavity
    1 = with a small cavity
12. Colpus shape
    0 = regular or continuous
    1 = irregular or discontinuous
13. Floral nectaries
    0 = without nectaries
    1 = pore shape nectaries
    2 = cushion shape nectaries
14. Stamen structure
    0 = free anthers on branches of filaments
    1 = free anthers sessile on filaments column
    2 = anthers and filaments fused into a column

columns, PCO was performed using the same dissimilarity matrix as in the cluster analysis. For the PCO by rows, a new dissimilarity matrix with the distances between variables was calculated. In both cases the dissimilarity matrices were transformed into their scalar products by means of a double centring procedure (see Rohlf, 1989: 6.25), so that their eigenvalues and eigenvectors could be computed.

RESULTS AND DISCUSSION

The results and discussion are presented in two sections: the first includes descriptions and illustrations of the pollen morphology, while the second encompasses the analysis and discussion of the results of the numerical taxonomic study.

1. Pollen Morphology

A. General Features of the Pollen Grains

Comparative illustrations of the taxa studied are included in Plates I (LM) and II (SEM). Plate I includes complete pollen grains (in polar view) of the 15 taxa considered in the study, showing the most typical palynological features of the subtribe Sicyinae (spiniferous, colporate) recognized by Jeffrey (1990). However, general interspecific differences in size, shape and number of colpi of the grains, as well as in size and shape of the spines, can be clearly observed. Under the SEM (Plate II), differences in ornamentation (e.g. reticulation in the interspinal area) are more evident and confirm the observations made under light microscope.

B. Palynological Descriptions

Sechium compositum (Donn.-Sm.) C.Jeffrey (Plate III: 1–6)

Eumonad, isopolar, radiosymmetric; oblate (60.8 × 81.0 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 4.3–6.3 μm long, with a small cavity near the top. Interspinal area microreticulate. Exine 3.0 μm thick; sexine thicker than nexine; amb circular.

***Sechium edule* (Jacq.) Swartz**

***S. edule* (wild)** (Plate III: 7–13)
Eumonad, isopolar, radiosymmetric; suboblate (64.0 × 82.7 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 4.9–7.2 μm long, with a small cavity near the

Table 4 Data matrix showing the values found for the 14 characters (columns) in the 15 taxa (rows) of *Sechium* sensu lato and its allies included in this study. For the purpose of the numerical taxonomic study, OTUs were used as columns and characters were used as rows (N = number of pollen grains examined).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sechium compositum	(N=240)	60.8	81.0	5.1	3.0	9	0.74	0.26	0	0	1	1	0	1	0
S. edule 'wild'	(N=240)	64.0	82.7	6.0	2.5	9	0.77	0.55	0	1	1	1	0	1	0
S. edule 'cultivated'	(N=240)	66.8	90.4	3.4	2.3	11	0.73	0.60	1	0	2	1	0	1	0
S. hintonii	(N=160)	52.6	68.8	5.8	2.5	10	0.76	0.36	0	1	1	1	0	1	0
S. pittieri	(N=240)	48.5	64.4	6.4	2.8	9	0.75	0.36	0	1	1	1	0	2	2
S. tacaco	(N=240)	78.3	87.6	6.5	3.0	9	0.89	0.34	0	2	1	1	0	1	1
S. talamancense	(N=160)	46.3	60.8	5.5	3.5	9	-.76	0.49	0	1	1	1	0	1	1
S. villosum	(N= 80)	54.3	73.7	8.4	2.5	9	0.73	0.40	2	0	1	1	0	2	2
Frantzia panamensis	(N= 80)	73.0	81.2	5.4	2.7	9	0.89	0.32	0	2	1	1	0	2	2
F. venosa	(N=160)	69.3	76.1	4.9	2.8	9	0.91	0.34	0	2	1	1	0	2	2
Parasicyos maculatus	(N= 80)	40.1	41.7	4.4	2.2	9	0.96	0.21	2	2	0	0	0	0	1
Microsechium helleri	(N= 80)	68.9	72.8	5.1	2.3	7	0.94	0.19	0	2	1	0	1	0	0
Pterosicyos laciniatus	(N= 80)	58.1	60.3	4.3	2.5	9	0.96	0.36	0	2	0	0	0	1	2
Sechiopsis triquetra	(N= 80)	52.2	60.5	4.0	2.5	10	0.86	0.39	0	1	0	1	0	1	2
Sicyos motozintlensis	(N= 80)	59.7	61.7	3.8	2.1	9	0.96	0.30	0	2	0	0	0	0	2

BRITISH MUSEUM
(NATURAL HISTORY)
113
- 3DEC1992
PRESENTED
LIBRARY

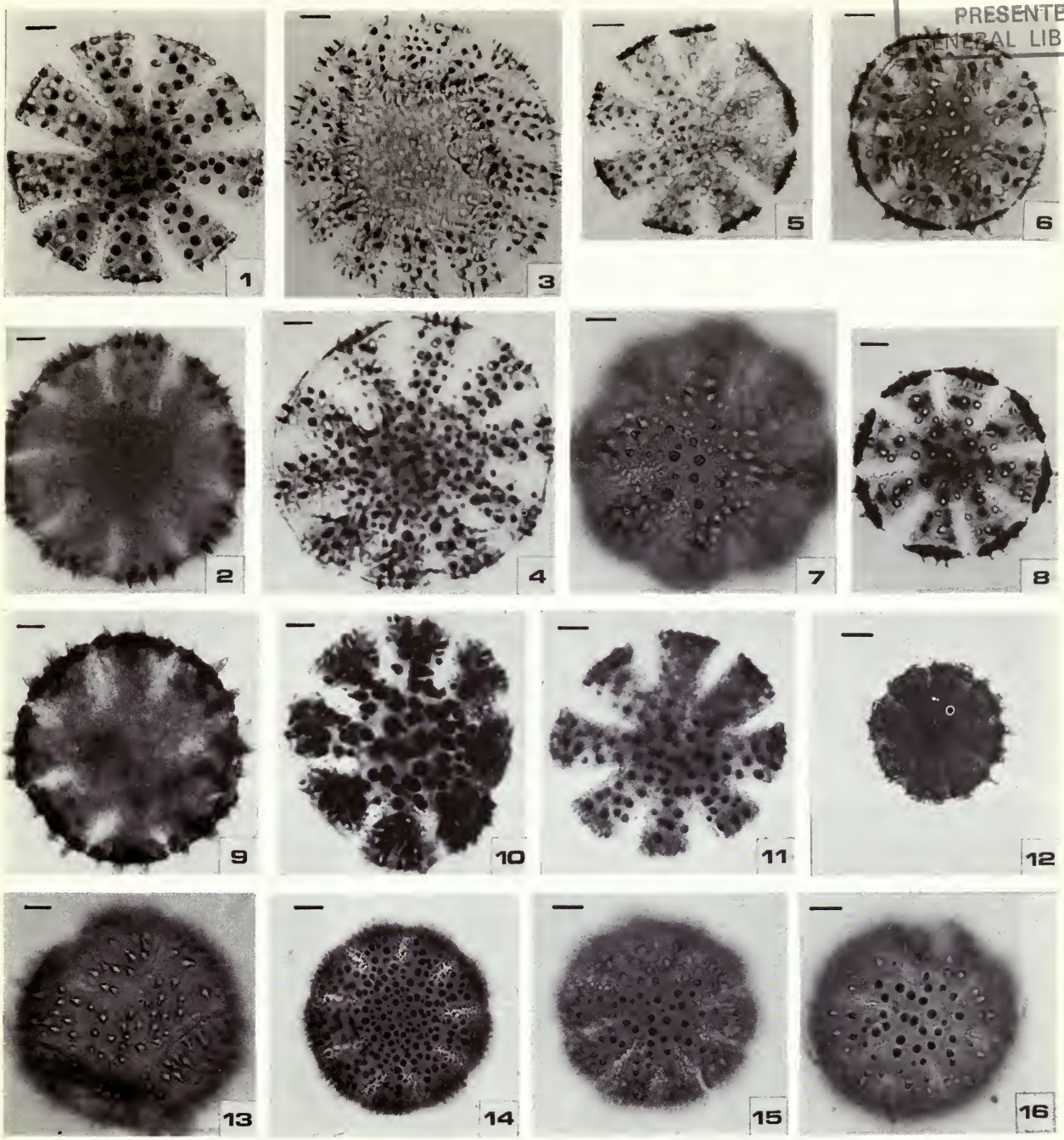


Plate I Comparative illustrations of the 15 taxa studied; polar view. 1, *Sechium compositum*; 2, *S. edule* (wild); 3, 4, *S. edule* (cultivated); 5, *S. hintonii*; 6, *S. pittieri*; 7, *S. tacaco*; 8, *S. talamancense*; 9, *S. villosum*; 10, *Frantzia panamensis*; 11, *F. venosa*; 12, *Parasicyos maculatus*; 13, *Microsechium helleri*; 14, *Pterosicyos laciniatus*; 15, *Sechiopsis triquetra*; 16, *Sicyos motozintlensis*. (bar scale = 10 μm).

top. Interspinal area microreticulate. Exine 2.5 μm thick; sexine thicker than nexine; amb circular.

***S. edule* (cultivated)** (Plate III: 14–19)
Eumonad, isopolar, radiosymmetric; oblate (66.8 × 90.4 μm), stephanocolpate (9–11 colpi). Tectate; spiniferous, cylindrical spines very variable in size (1.3–6.7 μm), with blunt end, with a small cavity near the top; also with clavate and verrucate ornamentation. Interspinal area faintly microreticulate. Exine 2.3 μm thick; sexine thinner than nexine toward the colpi margin; amb circular.

Sechium hintonii (P.G. Wilson) C. Jeffrey (Plate IV: 1–6)

Eumonad, isopolar, radiosymmetric; suboblate (52.6 × 68.8 μm), stephanocolpate (9–10 colpi). Tectate; spiniferous, conical spines 5.4–6.3 μm long, with a small cavity near the top. Interspinal area faintly microreticulate. Exine 2.5 μm thick; sexine slightly thicker than nexine; amb circular.

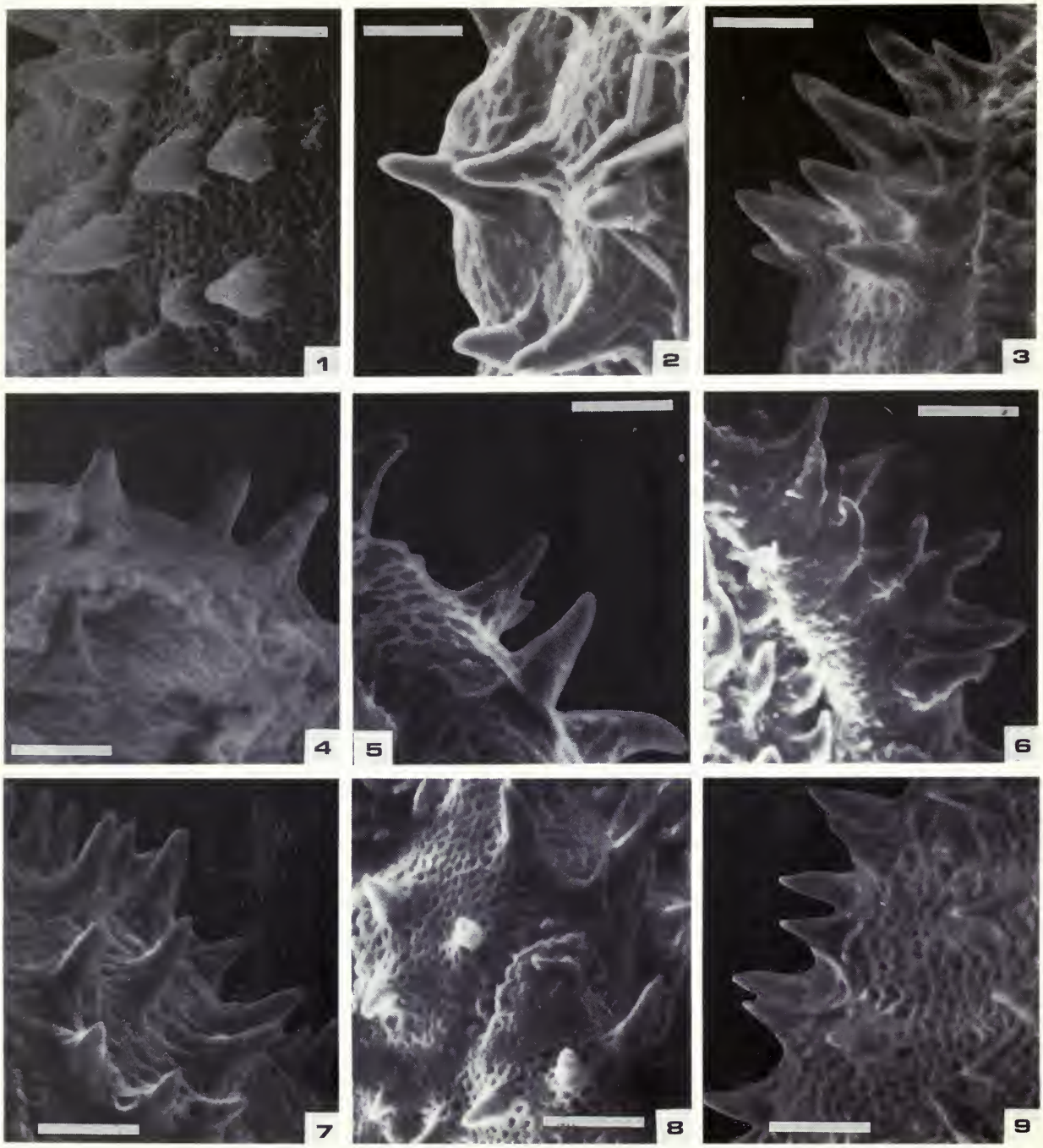


Plate II Comparative SEM illustrations of the pollen grains of nine of the taxa included in the study. 1, *Sechium edule* (wild); 2, *S. pittieri*; 3, *S. tacaco*; 4, *S. talamancense*; 5, *S. villosum*; 6, *Frantzia panamensis*; 7, *F. venosa*; 8, *Parasicyos maculatus*; 9, *Microsechium helleri*. (bar scale = 5 μm).

Sechium pittieri (Cogn.) C. Jeffrey (Plate IV: 7–10)

Eumonad, isopolar, radiosymmetric; suboblate (48.5 × 64.4 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 5.6–7.1 μm long, with a small cavity near the top. Interspinal area faintly microreticulate. Exine 2.8 μm thick; sexine slightly thicker than nexine; amb circular.

Sechium tacaco (Pittier) C. Jeffrey (Plate IV: 11–14)

Eumonad, isopolar, radiosymmetric; oblate-spheroidal (78.3 × 87.6 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 6.1–7.2 μm long, with a small cavity near the top. Interspinal area microreticulate. Exine 3.0 μm thick; sexine slightly thicker than nexine; amb circular.

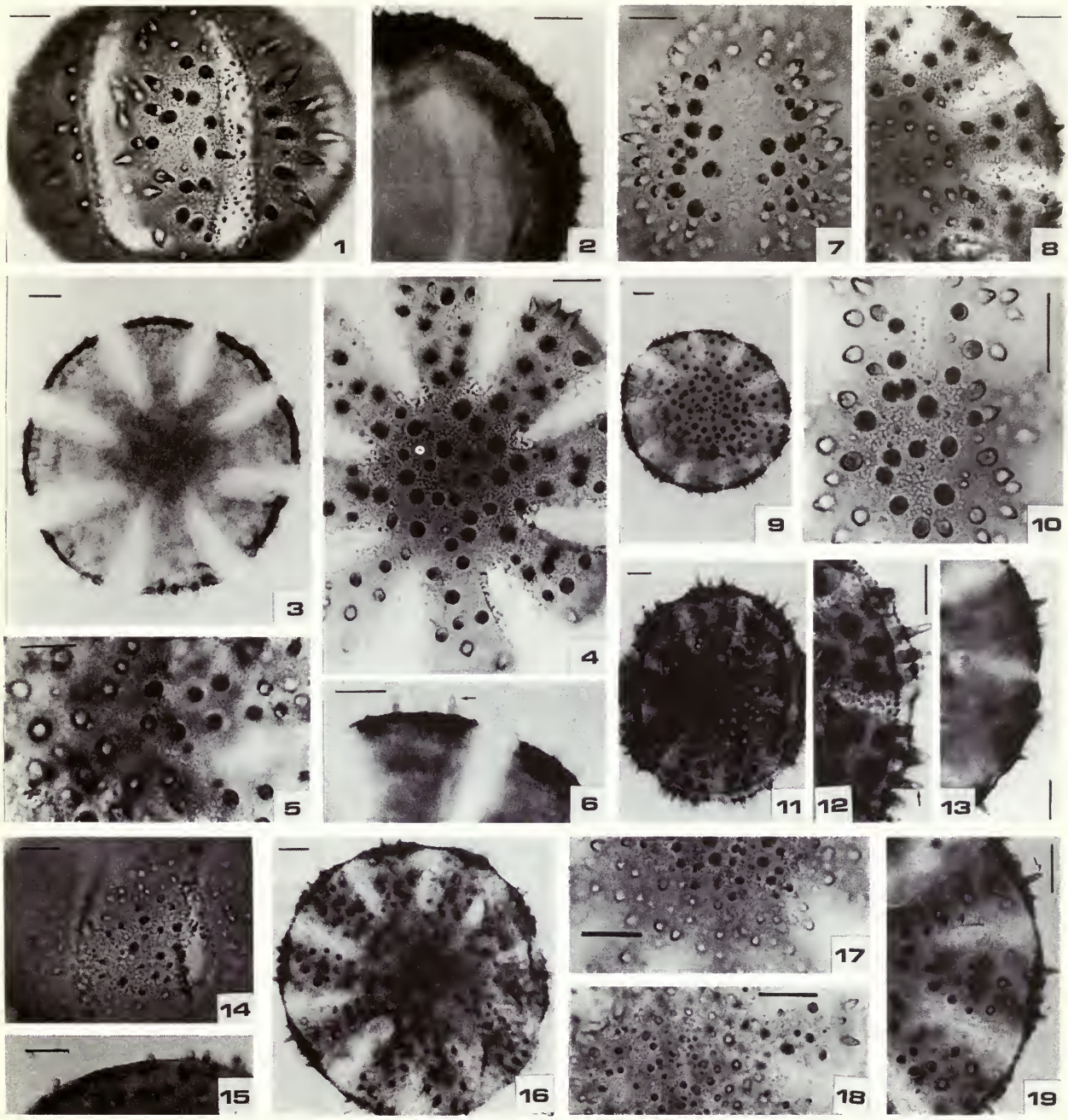


Plate III *Sechium compositum*. 1, equatorial view, high focus; 2, equatorial view, cross section; 3, polar view, cross section; 4, polar view, high focus; 5, apocolpium; 6, polar view, cross section. *S. edule* (wild). 7, equatorial view, high focus; 8, 9, polar view, high focus; 10, apocolpium; 11–13, polar view, cross section. *S. edule* (cultivated). 14, equatorial view, high focus; 15, 16, 19, polar view, cross section; 17, 18, apocolpium. (bar scale = 10 μm).

Sechium talamancense (Wunderlin) C.Jeffrey (Plate IV: 15–17)

Eumonad, isopolar, radiosymmetric; suboblate (46.3 × 60.8 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines very variable in size (3.6–8.1 μm), with a small cavity near the top. Interspinal area microreticulate. Exine 3.5 μm thick; sexine thicker than nexine; amb circular.

Sechium villosum (Wunderlin) C. Jeffrey (Plate V: 1–4)

Eumonad, isopolar, radiosymmetric; oblate (54.3 × 73.7 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines very long (7.2–9.9 μm), with a small cavity near the top. Interspinal area reticulate. Exine 2.5 μm thick; sexine as thick as nexine; amb circular.

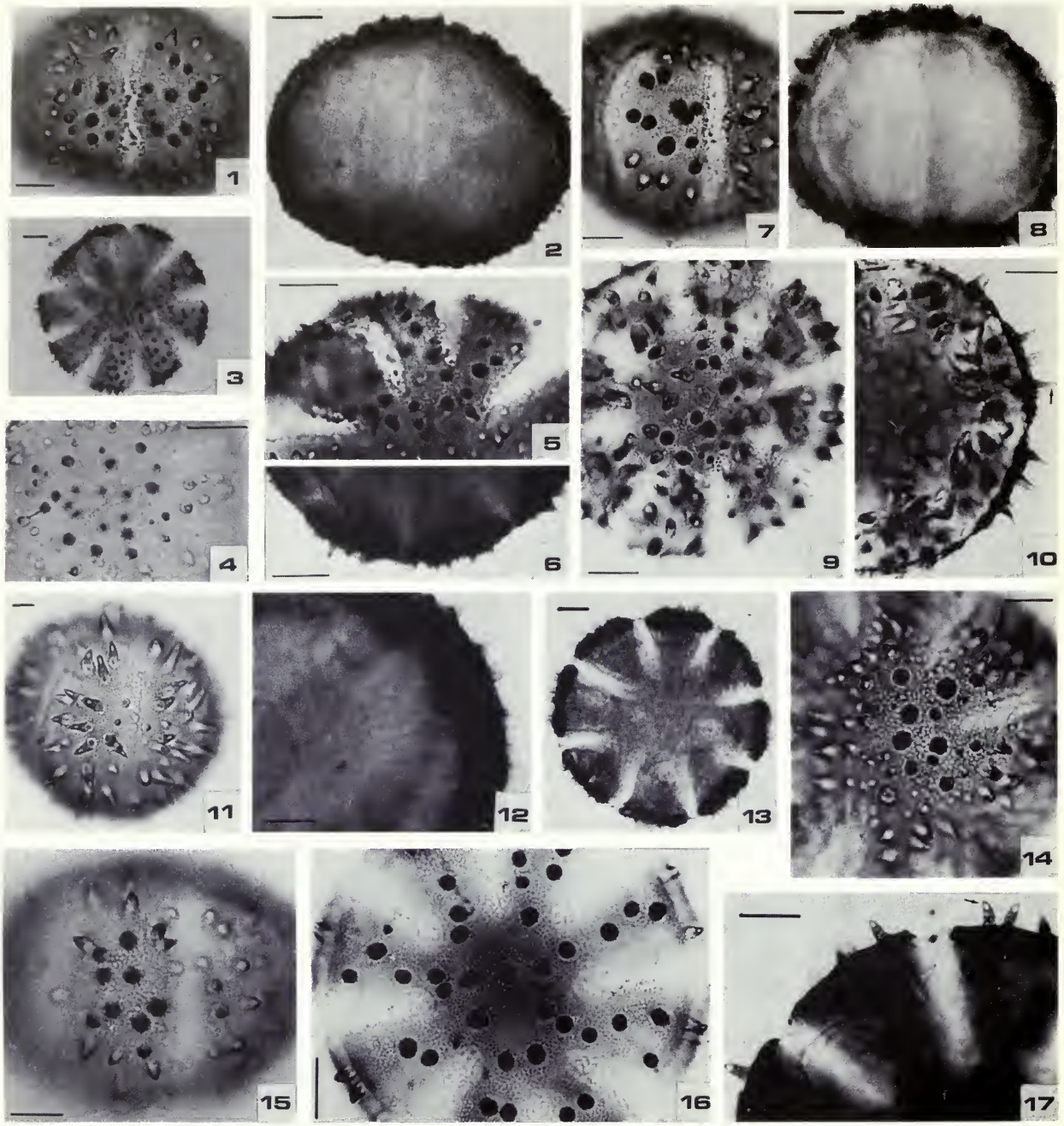


Plate IV *Sechium hintonii*. 1, equatorial view, high focus; 2, equatorial view, cross section; 3, 5, polar view, high focus; 4, apocolpium; 6, polar view, cross section. *S. pittieri*. 7, equatorial view, high focus; 8, equatorial view; cross section; 9, polar view, high focus; 10, polar view, cross section. *S. tacaco*. 11, equatorial view, high focus; 12, equatorial view; cross section; 13, polar view, cross section; 14, polar view, high focus. *S. talamencense*. 15, equatorial view, high focus; 16, polar view, apocolpium; 17, polar view, cross section. (bar scale = 10μm).

Frantzia panamensis Wunderlin (Plate V: 5–8)

Eumonad, isopolar, radiosymmetric; oblate-spheroidal (73.0 × 81.2 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 4.9–5.8 μm long, with a small cavity near the top. Interspinal area faintly microreticulate. Exine 2.7 μm thick; sexine slightly thicker than nexine; amb circular.

Frantzia venosa L.D. Gómez (Plate V: 9–12)

Eumonad, isopolar, radiosymmetric; oblate-spheroidal (69.3 × 76.1 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 4.4–5.7 μm long, with a small cavity near the top. Interspinal area faintly microreticulate. Exine 2.8 μm thick; sexine as thick as nexine; amb circular.

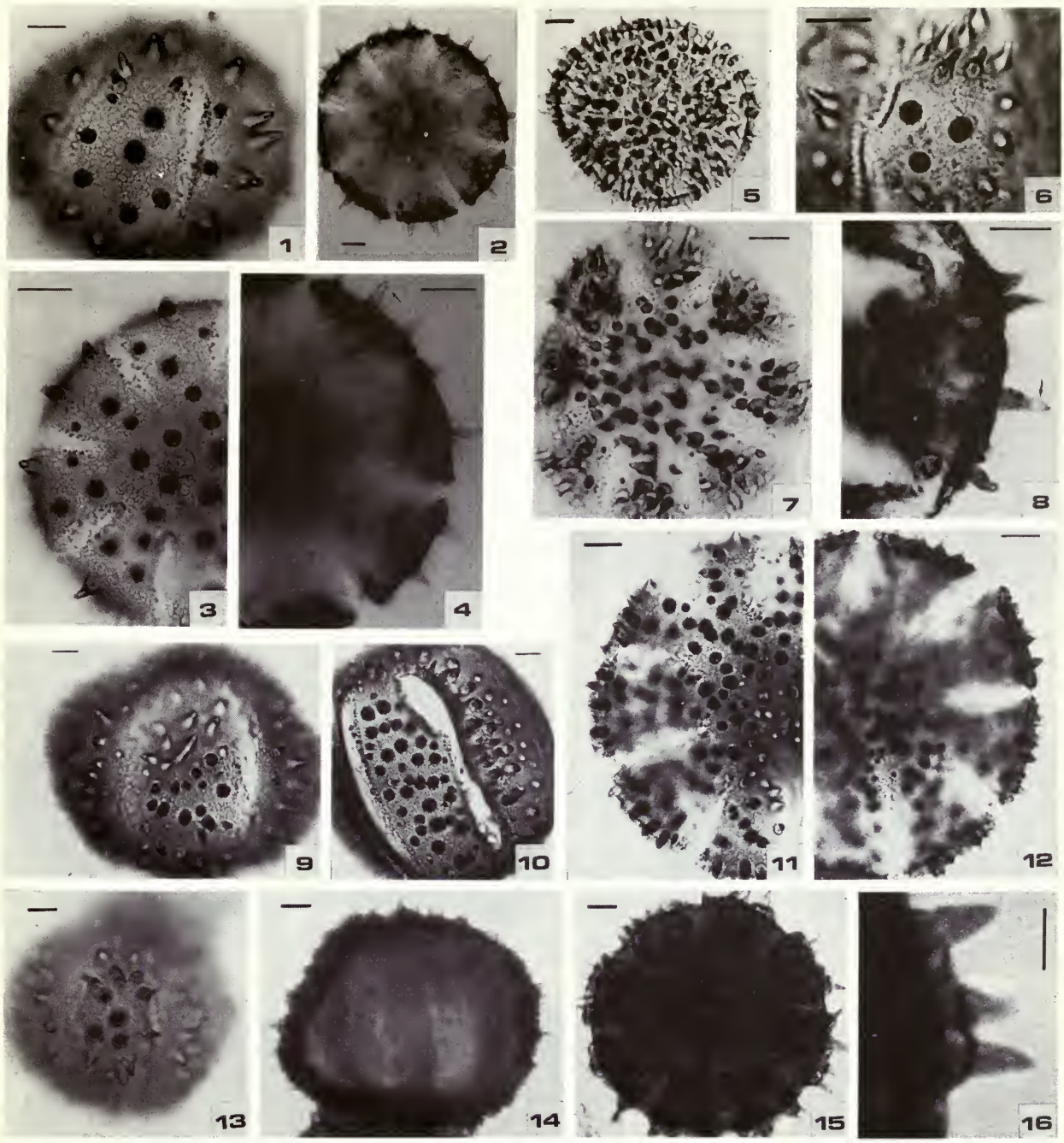


Plate V *Sechium villosum*. 1, equatorial view, high focus; 2, polar view, cross section; 3, polar view, high focus; 4, polar view, cross section. *Frantzia panamensis*. 5, equatorial view; cross section; 6, mesocolpium detail; 7, polar view, high focus; 8, polar view, detail of spines, cross section. *F. venosa*. 9, 10, equatorial view; 11, polar view, high focus; 12, polar view, cross section. *Parasicyos maculatus*. 13, equatorial view, high focus; 14, equatorial view; cross section; 15, 16, polar view, cross section, detail of spines. (bar scale = 10μm).

Parasicyos maculatus Dieterle (Plate V: 13–16)

Eumonad, isopolar, radiosymmetric; oblate-spheroidal (40.1 × 41.7 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 4.1–4.9 mm. Interspinal area reticulate. Exine 2.2 μm thick; sexine thicker than nexine; amb circular.

Microsechium helleri (Peyr.) Cogn. (Plate VI: 1–4)

Eumonad, pseudoisopolar, asymmetric; oblate-spheroidal (68.9 × 72.8 μm); heterocolpate (colpi 7 of different sizes). Tectate; spiniferous, conical spines 4.5–5.7 μm long. Interspinal area microreticulate. Exine 2.3 μm thick; sexine thicker than nexine; amb circular.

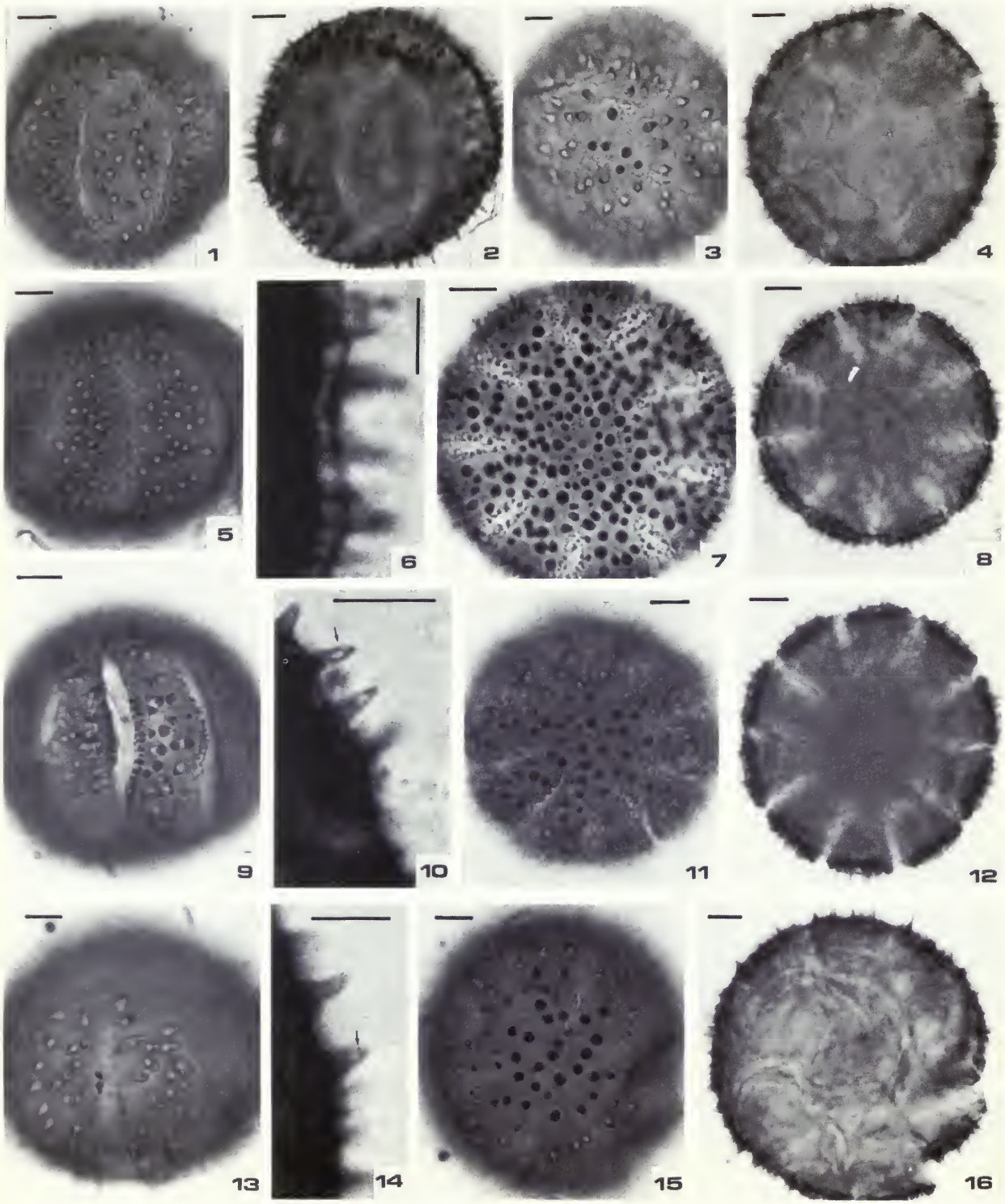


Plate VI *Microsechium helleri*. 1, equatorial view, high focus; 2, equatorial view, cross section; 3, polar view, high focus; 4, polar view, cross section. *Pterosicysos laciniatus*. 5, equatorial view, high focus; 6, equatorial view; cross section, spines detail; 7, polar view, high focus; 8, polar view, cross section. *Sechiopsis triquetra*. 9, equatorial view, high focus; 10, equatorial view; cross section; 11, polar view, high focus; 12, polar view, cross section. *Sicyos motozintlensis*. 13, equatorial view, high focus; 14, equatorial view; cross section; 15, polar view, high focus; 16, polar view, cross section. (bar scale = 10μm).

Pterosicyos laciniatus Brandegee (Plate VI: 5–8)

Eumonad, isopolar, radiosymmetric; oblate-spheroidal (58.1 × 60.3 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 3.6–5.1 μm long. Interspinal area microreticulate. Exine 2.5 μm thick; sexine thicker than nexine; amb circular.

Sechiopsis triquetra (Ser.) Naudin (Plate VI: 9–12)

Eumonad, isopolar, radiosymmetric; suboblate (52.2 × 60.5 μm), stephanocolpate (9–10 colpi). Tectate; spiniferous, conical spines 3.6–4.7 μm long, with a small cavity near the top. Interspinal area microreticulate. Exine 2.5 μm thick; sexine thicker than nexine; amb circular.

Sicyos motozintlensis Lott & Fryxell (Plate VI: 13–16)

Eumonad, isopolar, radiosymmetric; oblate-spheroidal (59.7 × 61.7 μm), stephanocolpate (8–9 colpi). Tectate; spiniferous, conical spines 3.1–4.5 μm long. Interspinal area microreticulate. Exine 2.1 μm thick; sexine as thick as nexine; amb circular.

2. Numerical Taxonomic Study

A. Cluster Analysis

As can be seen from the phenogram resulting from the cluster analysis (Fig. 1), two main clusters can be observed. The first is made up of eight taxa, all belonging to *Sechium* and *Frantzia*; they are *Sechium compositum*, the wild forms of *S. edule*, *S. hintonii*, *S. pittieri*, *S. tacaco*, *S. talamancense*, *Frantzia panamensis* and *F. venosa*. The second cluster includes only three species, two of which (*Sechiopsis triquetra* and *Pterosicyos laciniatus*) belong to the two closely related genera, which Kearns (in press) has proposed should be united under *Sechiopsis*. The other species in this cluster is *Sicyos motozintlensis*, a species pertaining to a genus which has been considered as not closely related to either *Sechiopsis* or *Pterosicyos*. Nevertheless, the phenogram shows the above-mentioned species as palynologically similar to *S. triquetra*. The four remaining taxa (cultivated *Sechium edule*, *S. villosum*, *Microsechium helleri* and *Parasicyos maculatus*), are clearly apart from the two previously described groups.

In the first cluster, two subgroups can be observed. The first places taxa belonging to the two sections of *Sechium* sensu lato close to each other. This subgroup is formed by *Sechium compositum*, wild *S. edule* and *S. hintonii* (all of section *Sechium*) and *S. pittieri* (of section *Frantzia*), which is placed next to *S. talamancense* (of section *Sechium*). The second subgroup is formed by *S. tacaco* (of section *Sechium*), and *Frantzia panamensis* and *F. venosa*, both of which, if transfered to *Sechium*, would fall under section *Frantzia*, for they present 'cushion like' nectaries. Of the 15 taxa studied, *Frantzia panamensis* and *F. venosa* are the two most closely related species, although some macromorphological features (e.g. inflorescence type), readily set them apart.

B. Ordination Techniques

As can be seen from Fig. 2, the results of PCO are in general consistent with those of the Cluster Analysis. Furthermore they provide a sharper definition of the different clusters described above. The results of PCO indicate that the characters which contribute the most to cluster formation are the polar/equatorial ratio and the type of spine apex in the first principal coordinate, while in the second principal coordinate, the most important characters are the length of the polar axis, and the number of colpi (Table 5). The character with higher loadings in the third principal coordinate is the type of grain ornamentation. In contrast with the palynological characters, none of the floral characters contributed significantly to the variation. The first three principal coordinates explain 70.7% of the variation (Table 5).

The representation of the OTUs in a bidimensional space of characters (Fig. 2.) shows that all the species of *Sechium* and *Frantzia* are closer to one another than to the majority of the species of the other genera. In the cluster formed by these species it is possible to identify subgroups that are in agreement with the interspecific relationships proposed elsewhere. Thus, wild *Sechium edule* and *S. compositum* are very close to each other. This is consistent with the chemical evidence of kinship between these two species found by Newstrom (1986, 1989). Likewise *Frantzia venosa* and *F. panamensis* are the

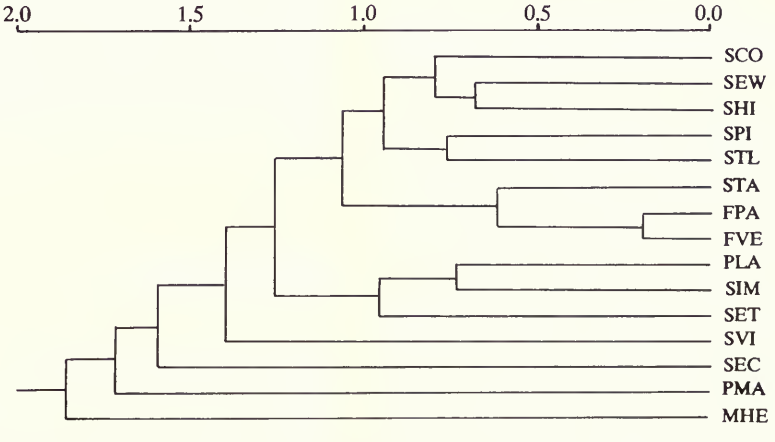


Fig. 1 Phenogram showing the similarity between the taxa of *Sechium s. l.* and its allies (Cophenetic Correlation Coefficient = 0.849). Taxa acronyms = SCO (*Sechium compositum*); SEC (cultivated *S. edule*); SEW (wild *S. edule*); SHI (*S. hintonii*); SPI (*S. pittieri*); STA (*S. tacaco*); STL (*S. talamancense*); SVI (*S. villosum*); FPA (*Frantzia panamensis*); FVE (*F. venosa*); MHE (*Microsechium helleri*); PMA (*Parasicyos maculatus*); PLA (*Pterosicyos laciniatus*); SET (*Sechiopsis triquetra*); SIM (*Sicyos motozintlensis*).

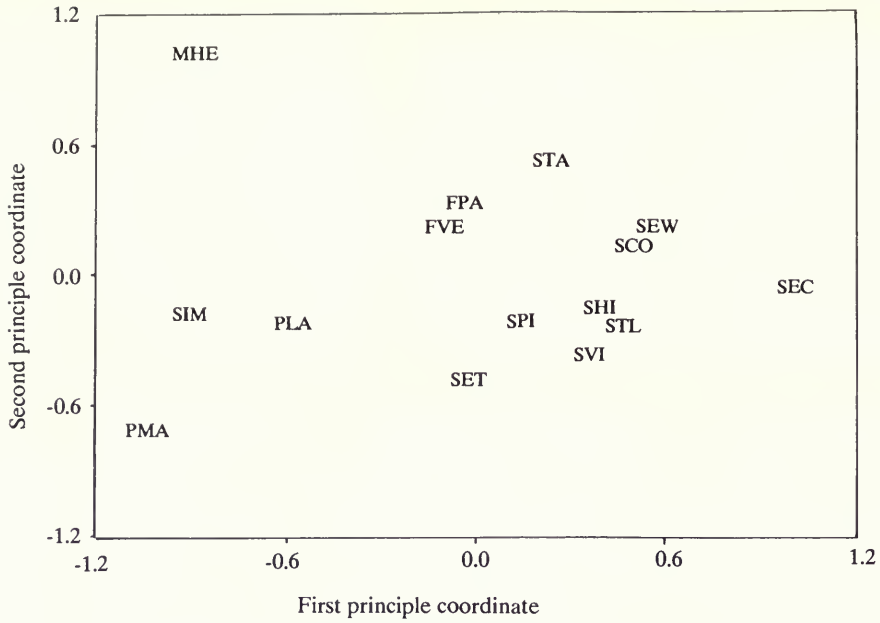


Fig. 2 Representation of; the taxa of *Sechium s. l.* and its allies in a bidimensional space of characters resulting form a Principal Coordinate Analysis. Taxa acronyms = SCO (*Sechium compositum*); SEC (cultivated *S. edule*); SEW (wild *S. edule*); SHI (*S. hintonii*); SPI (*S. pittieri*); STA (*S. tacaco*); STL (*S. talamancense*); SVI (*S. villosum*); FPA (*Frantzia panamensis*); FVE (*F. venosa*); MHE (*Microsechium helleri*); PMA (*Parasicyos maculatus*); PLA (*Pterosicyos laciniatus*); SET (*Sechiopsis triquetra*); SIM (*Sicyos motozintlensis*).

Table 5 Variation explained by the three first principal coordinates and the palynological characters with higher loading in each principal coordinate.

	Variation explained (%)	Characters
1st principal coordinate	39.46	Polar/equatorial ratio and apex of spines
2nd principal coordinate	18.05	Polar axis and number of colpi
3rd principal coordinate	13.24	Grain ornamentation

two most closely related species and make up a very well-defined group, though, in this case, they lie somewhat apart from *S. tacaco*.

The grouping of the species of *Sechium* according to the two *Sechium* sections defined by Jeffrey (1978), could not be observed with this type of analysis, since species belonging to different sections appear very close together, as in the group formed by *Sechium hintonii*, *S. talamancense*, *S. villosum* (all of section *Sechium*) and *S. pittieri* (of section *Frantzia*).

It is important to notice the position of the two cultivated taxa (*S. edule* and *S. tacaco*) in the graph resulting from PCO (Fig. 2). These two taxa, particularly *S. edule*, lie far apart from the rest of the species of the *Sechium-Frantzia* group. We do not have a clear explanation for this. However, some answers may be found in the extreme average values that these species have for characters which contribute the most to the variation, such as the polar/equatorial axis ratio and the ornamentation in *S.edule*, as well as the length of the polar axis in *S. tacaco*. In the case of *S. tacaco*, the most notable difference in its pollen grains is the length of the polar axis (78.3 μm), which was the longest recorded in this study (Table 4). As for cultivated *Sechium edule*, the polar/equatorial ratio of its pollen grains (0.73) was one of the two lowest recorded. Furthermore, the ornamentation observed in the grains of this taxon (spiniferous- clavate-microreticulate) was unique among all the taxa studied. These kinds of palynological differences have also been found between cultivated and wild species of *Cucurbita* by Ayala-Nieto et al. (1988). This suggests that pollen of Cucurbitaceae is a structure which has been unconsciously modified through the process of selection under domestication by humans.

Related to the species of *Sechiopsis* and *Pterosicyos*, the results obtained from both Cluster Analysis and PCO show that these two genera are relatively close to one another, occupying an intermediate position between the *Sechium-Frantzia* group and the rest of the genera (*Microsechium*, *Parasicyos* and *Sicyos*), though now clearly separated from *Sicyos motozintlensis*. On the other hand, *Microsechium*, *Parasicyos* and *Sicyos*, are definitely distant both from one another and from the two main groupings described above (*Sechium-Frantzia* and *Pterosicyos-Sechiopsis*).

CONCLUSIONS

The segregation of the subtribe Sicyinae proposed by Jeffrey (1990) was partially based on a series of palynological attributes such as the 7–10 colporate and the spiniferous pollen grain characters. The pollen morphology observed from the species studied here is consistent with Jeffrey's criterion. However, as seen from this study, the pollen morphology is highly variable at the level of genera and species within the above-mentioned subtribe. The more vari-

able pollen characters are the polar/equatorial index, the form of the apex of the spines, the length of the polar axis, the number of colpi and the grain ornamentation.

The results from the numeric taxonomic study give some support to the idea that pollen morphology is significant in the delimitation of genera within the Cucurbitaceae. These results also indicate a strong palynological relationship between the species of *Sechium* sensu lato and *Frantzia*, since both cluster analysis and ordination techniques showed these species grouping together and separated from the other species and genera studied here.

This palynological relationship supports Jeffrey's (1978) proposal of including *Frantzia*, *Polakowskia* and *Ahzolia* within the limits of *Sechium*. However, the splitting of this genus into sections based on floral characters by that author was not evident. The numerical taxonomic analysis has shown that the clustering of the species does not reflect such sections, even though the analysis included important floral characters.

Nevertheless, it is clear that the final assessment of the generic limits of *Sechium* and its relatives should be the result of an integrative study involving a larger number of characters as well as a variety of systematic approaches.

ACKNOWLEDGEMENTS. This paper forms part of the project 'Taxonomic and Ecogeographic Studies in Cucurbitaceae of Latin America', sponsored by the International Board for Plant Genetic Resources (IBPGR), and conducted by the second author in the Herbario Nacional de México, Instituto de Biología, U.N.A.M.

We wish to thank the authorities of Herbario Nacional de México, especially Alfonso Delgado and Patricia Dávila, and Instituto Nacional de Antropología e Historia de México, especially Mario Aliphat, for the facilities provided to carry out this study. To María del Rosario García for the procurement of specimen loans, and to the curators of BM, CHAPA, GH, K, MICH, MO and XAL for the loans of the specimens entrusted to their care. Thanks to the Laboratorio de Micromecánica, Instituto de Ingeniería, U.N.A.M., especially Ricardo Peralta, Armando Peralta and Orlando Palacios for their help to use the Scanning Electron Microscope.

Robert Bye (Jardín Botánico del Instituto de Biología, U.N.A.M.), Fernando Chiang, Patricia Dávila, Oswaldo Tellez (MEXU), Daniel Debouck (IBPGR-Roma), Stephen Blackmore, Rob Huxley and David Sutton (BM) read and commented on the manuscript. The latter two also assisted in the English of the manuscript. The second author thanks Jose Carmen Soto (Colegio de Ciencias y Humanidades, U.N.A.M.), Alberto Reyes (MEXU), Rafael Ocampo (CATIE), Carlos Astorga (IBPGR-CATIE) and Abdenago Brenes (Universidad Nacional Heredia Costa Rica), for assistance in the field.

REFERENCES

Aleshina, L.A. 1964. On the pollen grains of the Cucurbitaceae (in Russian). *Bot. Zhurn. SSSR* **49**(12): 1773–1776.

Ayala-Nieto, M., Lira-Saade, R. & Alvarado, J.L. 1988. Morfología polínica de las Cucurbitáceae de la Península de Yucatán. *Pollen et Spores* **30**(1): 5–28.

Dieterle, J.V.A. 1976. Cucurbitaceae. In: Flora of Guatemala. *Fieldiana Bot.* **24**(11): 306–395.

Dunn, G. & Everitt, B.S. 1982. *An Introduction to Mathematical Taxonomy*. Cambridge.

Erdtman, G. 1943. *An Introduction to Pollen Analysis*. New York.

Erdtman, G. 1952. *Pollen Morphology and Plant Taxonomy. Angiosperms*. New York.

Faegri, K & Iversen, J. 1964. *Text Book of Pollen Analysis*. Copenhagen.

Gómez, L.D. & Gómez J. 1984. Plantae Mesoamericanae Novae. IX. *Phytologia* **53**(6): 447–448.

Jeffrey, C. 1964. A note on pollen morphology in Cucurbitaceae. *Kew Bull.* **17**: 473–477.

—— 1978. Further notes on Cucurbitaceae. IV. Some New World taxa. *Kew Bull.* **33**: 347–380.

—— 1980. A review of the Cucurbitaceae. *J. Linn. Soc. Bot.* **81**: 233–247.

—— 1990. An outline classification of the Cucurbitaceae. *In*: D.M. Bates, R.W. Robinson & C. Jeffrey (Eds). *Biology and Utilization of the Cucurbitaceae*: 449–463. Ithaca.

Kearns, D.M. A review of the genus *Sechiopsis*. *Syst. Bot.* in press.

Kremp, G.O.W. 1965. *Morphologic Encyclopedia of Palynology*. Tucson.

Marticorena, C. 1963. Material para una monografía del polen de Cucurbitaceae. *Grana Palynologica* **4(1)**: 78–91.

Newstrom, L. 1986. *Studies in the origin and evolution of Sechium edule (Jacq.) Sw.* Ph.D. Thesis. University of California at Berkeley.

—— 1989. Reproductive biology and evolution of the cultivated chayote *Sechium edule*: Cucurbitaceae. *In*: J.H. Bock & Y.B. Linhart (Eds). *Evolutionary Ecology of Plants*: 491–509. Boulder.

—— 1990. Origin and evolution of chayote, *Sechium edule*. *In*: D.M. Bates, R.W. Robinson & C. Jeffrey (Eds). *Biology and Utilization of the Cucurbitaceae*: 141–149. Ithaca.

Page, J.S. & Jeffrey, C. 1975. A palynotaxonomic study of African *Peponium*. *Kew Bull.* **30**: 495–502.

Pittier, H. 1910. New or noteworthy plants from Colombia and Central America. *Contr. U.S. Natl. Herb.* **13**: 118–131.

Rangaswami, K. 1976. Palynological highlights of Cucurbitaceae. *In:* P.K.K. Nair (Ed.). *Advances in Pollen-Spore Research*. Vol.II 54–59. New Delhi.

Rodríguez-Jiménez, C. & Palacios-Chávez,R. 1991. Nota sobre la variación morfológica en las flores masculinas de *Microsechium helleri* (Peyr.) Cogn. (Cucurbitaceae). *Palynologica et Palaeobotanica.* **3 (1): 99–106.**

Rohlf, F.J. 1989. *NTSYS-pc. Numerical Taxonomy and Multivariate Analysis System. Version 1.50*. New York.

Romesburg, H. C. 1984. *Cluster Analysis for Researchers*. Belmont, California.

Singh, S & Singh,D. 1990. Palynology of the Indian Cucurbitaceae. *In*: D.M. Bates, R.W. Robinson & C. Jeffrey (Eds.) *Biology and Utilization of the Cucurbitaceae*: Ithaca.

Wilson, P.G. 1958. *Microsechium hintonii*. *In*: Contributions to the Flora of Tropical America: LXIII. *Kew Bull.* **13: 161.**

Wunderlin, R.P. 1976. Two new species and a new combination in *Frantzia* (Cucurbitaceae). *Brittonia* **28**(2): 239–244.

—— 1977. A new species of *Frantzia* (Cucurbitaceae) from Panama. *Bull. Torrey Bot. Club* **104(2)**: 102–104.

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 123–146 Issued 26 November 1992

Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. IV. Rhodophyta (Florideae) 3. Genera H–K

JAMES H. PRICE, DAVID M. JOHN AND GEORGE W. LAWSON

Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD

CONTENTS

Synopsis 123
Introduction 123
Species list 124
Acknowledgements 137
References in numerical order 137
References 140

SYNOPSIS. This paper assembles and, so far as is possible without extended field and herbarium studies, examines critically the validity of records of marine and brackish-water Rhodophyta (Florideae) for the western coast of tropical Africa. The whole mainland coastline from the northern boundary of Western Sahara southwards to the southern boundary of Namibia, the oceanic islands from the Salvage Islands southwards to Ascension and St Helena, and all islands close to the African mainland coast are included in the area covered. Each species entry includes all traced records for the species, the names which have previously been applied to it for the area, and additional comments or evaluation, as necessary. Comments are also provided at generic or generic group levels in very complex cases.

INTRODUCTION

The area dealt with in this part of the work is identical with that covered in parts published previously (Lawson & Price, 1969; Price, John & Lawson, 1978, 1986, 1988; John, Price, Maggs & Lawson, 1979). Country names employed and their earlier equivalents, and the names of island groups, are either listed in the legend or both listed and shown on the map in Fig. 1. Genera with the initial letter H–K and constituent species are listed in alphabetical order.

Each main entry consists of:

(i) **The major bold heading**, representing the currently-accepted name and authorities.

(ii) **Subsidiary italicised headings at intervals within the entry**. These are in square brackets and essentially subdivide the overall entry. They represent the different ways in which the species has been referred to throughout in past publications for the area. Incorrect citations from past literature have been maintained in these subsidiary heads so that there shall be no doubt as to which record we attribute to which species or lower taxon level; only when clarification was required for comprehension have changes been made in subhead citation, in which case explanation is given in intermediary or terminal notes.

(iii) **The distributional data**, with countries and island groups arranged in a single alphabetical order. More generalised but relevant statements of distribution follow the specific country list. Complete distribution patterns require a scan of records established under all names by which a species is known for this or adjacent areas. Hence, generalised distribution statements are included verbatim since it is not always clear for precisely which countries within the area they establish records.

References are presented in two ways:

(a) as a numbered list (p. 137) to allow inclusion of manuscript and expedition sources, and (b) as a list of full references in alphabetical order. Numbers within parentheses after the geographical names refer to corresponding numbers in the references. References relevant only in previous parts of this series are omitted here and numbers are therefore not fully standardised between the present and past parts.

(iv) **Additional qualifying notes** appear below whole entries or individual parts of entries to which they specifically refer. In these notes, references containing species records consist of authors' names, followed by the reference number in the terminal list and, where appropriate, the relevant page numbers after a colon. Other references consist of authors' names, date of publication and sometimes page numbers after a colon.

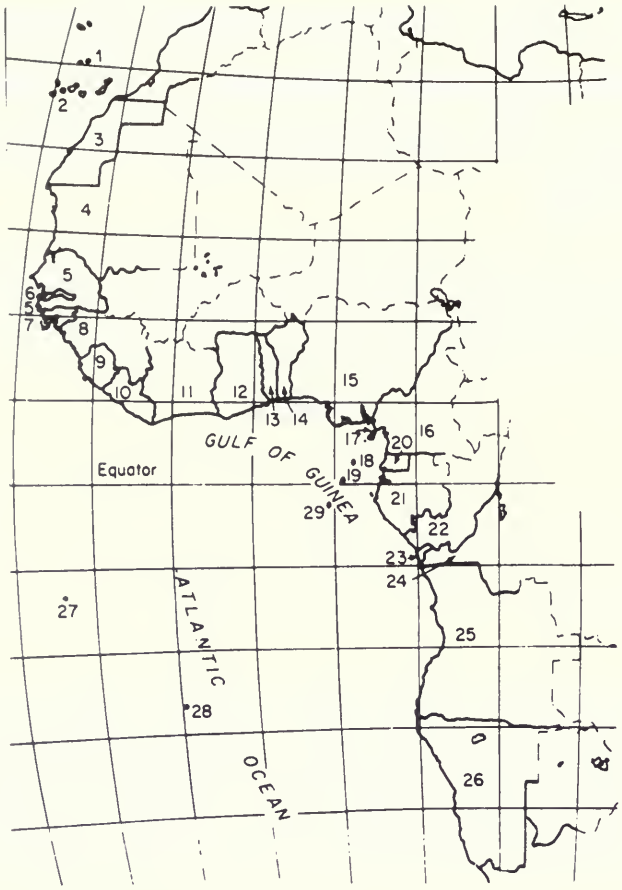


Fig. 1. The coastline of tropical west Africa and the offshore islands. 1, Salvage Islands; 2, Canary Islands; 3,*Western Sahara [=former Spanish Sahara, Spanish West Africa] (includes the often quoted Rio de Oro, the southern region of the country, but excludes Ifni); 4, Mauritanie; 5, Sénégal; 6, Gambia; 7, Guinea-Bissau [=Portuguese Guinea]; 8, Guinée; 9, Sierra Leone; 10, Liberia; 11, Côte d'Ivoire; 12, Ghana; 13, Togo; 14, Benin [=Dahomey]; 15, Nigeria; 16, Cameroun; 17,** Bioko [=Macias Nguema Biyogo, Fernando Póo]; 18, Príncipe; 19, São Tomé; 20,** Equatorial Guinea [=Spanish Guinea]; 21, Gabon; 22,*** Republic of the Congo; 23, Cabinda; 24, Zaire [=Congo Republic]; 25, Angola; 26, Namibia [=South West Africa]; 27, Ascension Island; 28, Saint Helena; 29, Pagalu [=Annobón]. The Cape Verde Islands, which lie immediately to the west of Dakar (Sénégal), have been omitted from this map but are included in the species list that follows.

* The former colony of Spanish Sahara no longer officially exists, the territory it once covered being divided, by agreement between Morocco and Mauritanie. The effective date of the division, Spain concurring, was 28 February 1976, although guerilla opposition delayed matters until a formal agreement on 14 April 1976. The attempt to maintain the territory as the Democratic Sahara [Saharan] Arab Republic has apparently entered the 'realm of myth' (Gretton, 1976). The authors' citation terminology is maintained throughout the records.

** Nos 17 (Bioko) and 20 (Spanish Guinea, = Rio Muni) on the original map (part I) are now jointly administered as Equatorial Guinea. Bioko is entered separately, where appropriate, in the species list.

*** Loango, a name much used by earlier collectors such as Welwitsch, was formerly a coastal region of West Africa. Its application appears to have included much of the coastline of the Republic of the Congo (22), as well as of Cabinda (23) and Zaire (24). Because by far the longest and rockiest part of the Loango coast lies now within the Republic of the Congo we have attributed all marine algal records from Loango to the Congo.

Species nomenclature has been revised as far as possible and the complete author citation is given for each currently-accepted combination. The subsidiary italicised headings and any other discarded combinations that require reference are included as cross-referencing entries to the currently-accepted names in the overall list. Without extended field and herbarium studies, the treatments presented here are essentially preliminary. Critical updating of the overall text is kept firmly in mind for the whole series and we would appreciate notification of any detected errors and omissions from any of the parts.

SPECIES LIST

Halarachnion ligulatum (Woodward) Kützing
Canaries (38D; 70; 191; 226; 227; 232B; 392; 584; 598).

'From Great Britain southwards to the Canary Islands' (70).
[As *Halymenia (Halarachnion) ligulata* (Woodward) Kützing]
Canaries (439).

Note. For interrelationship in life history between *Halarachnion ligulatum* and the crustose tetrasporophyte *Cruoria rosea*, see Boillot 1965, 1972). Data established by Boillot have subsequently been confirmed by Kornmann & Sahling (1977) and Maggs (1983). For a detailed study in *Halarachnion ligulatum* of development, vegetative and reproductive, see Knauss & Hommersand (1989), where also are discussed its grouping in Furcellariaceae and characterization/ analysis of this family.

Halarachnion sp.
For possible Canaries and Sénégal records, see *Halymenia* spp.

Halichrysis depressa (J. Agardh) Schousboe in Bornet
Bioko (346; 350; 586).
Ghana (350; 377; 586).
'. . . in the Mediterranean and tropical parts of the eastern Atlantic' (350; 586).
'Tropical Africa (N. Gambia—Congo river)'(598).
[As *Halichrysis depressa* (J. Agardh) Schmitz]
'. . . Atlantischer Ozean: Nordwestafrikanische küste. . .' (499).
[As *Halichrysis depressa* (Schousboe) Schmitz]
'. . . in wärmeren Teile des atlantischen Oceans. . .'(507).

Note. Plants with similar coloration, habit and vegetative structure have been found in Cameroun and Gabon. Gabon material has zonate tetraspores and was tentatively referred to *Meristotheca* (295). Sterile Ghanaian plants resemble *M. coacta* Okamura (299). Recent collections of cystocarpic plants have all been found to be *Halichrysis depressa* (350; 586), save for the record (Heincke Expedition, 1991) cited under *Halichrysis peltata* (q.v.).

Halichrysis peltata (W.R. Taylor) P. Huvé & H. Huvé
Canaries (635).

Haliptilon
Johansen & Womersley (1986: 562) commented that: 'The systematics of *Haliptilon* on a world-wide basis requires further study'. *Haliptilon* and *Jania* are more closely related than either is to *Corallina*—see the generic note to *Jania*. See also Johansen & Womersley (1986: 563) who presented a table of the characteristics distinguishing *Haliptilon* from *Corallina* in southern Australia.

Haliptilon cubense (Montagne ex Kützing) Garbary & Johansen
[As *Corallina cubensis* (Montagne) Kützing]
Canaries (13; 128A; 227; 306B; 582).
Cape Verde Islands (191; 500).
[As *Jania cubensis* Montagne in Kützing]
Cape Verde Islands (259).
[As *Jania cubensis* Kützing]
Cape Verde Islands (145).
[As *Jania cubensis* Montagne]
Cape Verde Islands (260).
[As *Corallina (Jania) cubensis* Montagne in Kützing]
Cape Verde Islands (38).

Haliptilon squamatum (Linnaeus) Johansen, L. Irvine & Webster
Canaries (Herb. BM; 541)
Western Sahara (349).
[As *Corallina squamata* Ellis et Solander]
Canaries (25; 134; 239; 283; 497; 499; 582).
Sénégal (50).
Western Sahara (33; 222).
'. . . a Britannia meridionali usque ad Insulas Canarienses. . .' (25; 134).
'. . . de l'Angleterre au Rio de Oro. . .' (33; 222).
'. . . depuis le partie sud de l'Angleterre jusqu'aux Canaries. . .' (283).
'. . . In Atlantischen Ozean von der südenglischen Küste bis zu den Kanaren. . .' (497; 499).
'. . . Nordwestafrika. . .' (499).
[As *Corallina squamata* Park.]
Canaries (254; 305).

Note. Bodard (50: 85) stated regarding his Sénégal material '*C. squamata*. . . n'est d'ailleurs à notre avis qu'une forme de *C. mediterranea* . . '. According to Afonso-Carrillo *et al.* (582), the presence of this species in the Canaries is doubtful.

Haliptilon subulatum (Ellis & Solander) Johansen
Ghana (350; 586).
Liberia (350; 586).
Mauritanie (349; 598; 624).
'Subtropical Africa [Senegal (N. of Gambia), Mauritania, Former W. Sahara]' (598).
'Tropical Africa (N. Gambia—Congo river)' (598).
[As *Haliptylon subulata* (Ellis & Solander) Johansen]
Liberia (129).

Note. Johansen & Womersley (1986: 562) stated: 'The diagnostic characteristics of *H. subulatum* are unknown, and as the type specimen is lost this species must be considered a *nomen nudum*. . .'. It seems highly likely then that if this is a good taxon it is more widespread throughout the list area than the few records would suggest.

Haliptilon virgatum (Zanardini) Garbary & Johansen
Canaries (387; 439; 448; 541; 598; 604; 605).
Salvage Islands (598).
'Tropical Africa (N. Gambia—Congo river)' (598).

Note. The epithet is rendered *virgata* by Garbary & Johansen (1982). They examined the ?type of *Corallina virgata* Zanardini and found it to possess surface morphology and trichocytes of a type similar to *Jania rubens*. See also notes to *Corallina granifera* Ellis & Solander. *Haliptilon cubense* (Montagne ex Kützing) Garbary & Johansen may also be implicated in the background to *H. virgatum*; see Johansen & Womersley (1986: 562). According to Prud'homme van Reine (*pers. comm.*, 19/11/91), from discussions with W. Johansen and J. Afonso-Carrillo it appears probable that material of *Corallina lobata* Lamouroux (q.v., Price *et al.* 1986: 75) from the Canaries actually represented *Haliptilon virgatum*.

Haliptilon spp.
West Africa (290).

Halodictyon mirabile Zanardini
Canaries (13; 38D; 71; 177; 190; 191; 227; 232B; 350; 556; 584; 586; 598; 604; 605).
Cape Verde Islands (598).
Salvage Islands (38B; 38D; 556; 598).
Sierra Leone (30; 350; 586).

Note. Aleem (1978) reported this plant growing on hydroids in the lower littoral at one location on the Sierra Leone peninsula. Although known from the islands, this is the first mention of the species from the mainland of West Africa and, until confirmed, the record must remain doubtful. Weisscher (1983: 66) indicated, with doubt, a record, presumably secondary, for Morocco.

Halophytis incurvus
See *Halopitys incurvus* (Hudson) Batters.

Halopithys incurvans (Hudson) Batters
See *Halopitys incurvus* (Hudson) Batters.

Halopitys incurvus (Hudson) Batters
Canaries (13; 38D; 128A; 191; 227; 232B; 306B; 375; 392; 517; 584; 598; 621).
Mauritanie (38D; 349).
'. . . Atlantique (de l'Angleterre à la Mauritanie). . .' (33).
'. . .Atlantique nord, du sud de l'Angleterre aux Canaries. . .' (190).
'. . . Atlantique nord jusqu'en Mauritanie. . .' (222).
'. . . British Isles and southward to W. Africa. . .'(375).
'. . . mediterranéo desde el sur de Inglaterra a Canarias' (517).
'Subtropical Africa [Senegal (N. of Gambia), Mauritania, Former W. Sahara]' (598).
[As *Halophytis incurvus* sine auctorum]
Canaries (128A)
[As *Halopithys incurvans* (Hudson) Batters]
Canaries (227; 238).
[As *Halopithys pinastroides* Kützing]
Canaries (89; 547).
'. . . Du sud de la Grande-Bretagne aux Canaries. . .' (89).
[As *Halopithys pinastroide*]
Canaries (237).
[As *Halopitys pinastroides* (Gmelin) Kützing]
Canaries (70; 71; 133; 236; 252; 322).
Mauritanie (252).
'. . . von Südengland bis zu den Canarischen Inseln. . .' (179).
'. . . From south of England down to the Canary islands. . .' (71).
'. . . wärmeren Teile des atlantischen Oceans. . .' (501).
[As *Halopithys pinastroides*]
Canaries (2).
'. . . Atlantique nord jusqu'en Mauritanie. . .' (222).
[As *Lophura episcopalis* (Montagne) Kützing]
Canaries (318; 323).
[As *Rhodomela episcopalis* Montagne]
Canaries (402; 407).
[As *Rhodomela pinastroides* Agardh]
Canaries (44).
[As *Rhodomela pinastroides* (Gmelin) C. Agardh var. *episcopalis* Montagne]
Canaries (401; 402).
[As *Rytiphlaea episcopalia* (Montagne) Endlicher]
Canaries (26).
[As *Rytiphloea pinastroides* C. Agardh]
Canaries (37; 401; 439).
[As *Rytiphlaea pinastroides* (Gmelin) C. Agardh]
'. . . in oceano atlantico calidiore ab insulis Canariensibus usque ad littora meridianalia Angliae. . .' (26).
'. . . Atlantischen Ocean (von den Kanaren bis England). . .' (37).
[As *Rytiphlaea pinastroides* (Turner) J. Agardh]
Canaries (258).
[As *Fucus lycopodioides* Flor. Dan.]
Canaries (90).

Note. There have been so many variations, accidental and purposeful, of spelling in generic and specific names that the majority have been ignored unless they were likely to lead to misunderstanding or nomenclatural confusion. For details of the attribution of *Fucus lycopodioides* here, see the earlier entry (Price *et al.*, 1986: 92-93) under that name. Kützing himself remarked (323: 15, no. 3535) below the figure legends for *Lophura episcopalis* that the alga belonged to the genus *Halopithys* [sic!], very close to and perhaps not specifically distinct from *H. pinastroides*. Essentially similar comments had earlier (1841) been made by Montagne (401: 153–154) in considering his var. *episcopalis* of *Rhodomela pinastroides*, based on material sent under the name *Rhodomela lycopodioides* by Despréaux to Webb.

Halopithys pinastroides sine auctorum
See *Halopitys incurvus* (Hudson) Batters.

Haloplegma duperreyi Montagne
'. . . ad oras Africae australis et austro-occidentales (sec. Sonder). . .' (24; 27; 133).

Note. It is not clear whether the south west coast here relates to the west coast of South Africa or the coast of South West Africa (now Namibia). In view of the lack of other records and general Indo-Pacific distribution probably the former is true and the entry therefore not relevant. Included for completeness only.

Halurus equisetifolius (Lightfoot) Kützing
Canaries (565A; 598; 605).
Mauritanie (33; 349; 529).
'de Inglaterra à Mauritania' (619; 622).
'. . . Atlantique (de l'Angleterre à la Mauritanie). . .' (33)
'. . . Atlantique nord: des côtes anglaises jusqu'au cap Blanc (Mauritanie). . .' (222).
[As *Halurus* sp.]
Mauritanie (245B).

Halymenia
This genus is imperfectly known and apparently highly polymorphic. Despite work by many authors over the last three decades there is still an insufficiently broad and critical database for the establishment of a satisfactory working taxonomy. The entries given here are therefore essentially preliminary and biogeographic conclusions are unwarranted as yet. Bodard (55: 14) commented on the difficulty of comparing herbarium materials in which resuscitation of structure is imperfect because of inseparable adjacent wall layers and faulty preservation in liquids, especially of the secretory cells. The wide distribution of forms referred to the genus in warm and temperate seas further complicates assignment of records. Recent treatment by Schneider & Searles (642: 276–282) should be consulted for details of some of the difficulties encountered, especially between the genera *Halymenia* and *Sebdenia* (642: 269–270).

Halymenia actinophysa Howe
Ghana (290; 292; 299; 300; 350; 376; 567; 586).
Mauritanie (624).
'. . . in tropical parts of the Pacific and Atlantic Oceans' (350; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).

Halymenia agardhii De Toni
Ghana (292; 299; 350; 376; 586).
Sénégal (50; 55; 56; 59; 399; 598).
'Tropical Africa (N. Gambia—Congo river)' (598).
'. . . widespread in warm temperate and tropical seas' (350; 586).

Note. See Cordeiro-Marino (108: 59) on the possible conspecificity of this species with *Halymenia polydactyla* Børgesen (from India) [=*Sebdenia polydactyla* (Børgesen) Balakrishnan]. See also the generic note above regarding data in Schneider & Searles (642) on these two potentially confusing genera. They indicated (p. 282) that Parkinson (1980) showed *Halymenia agardhii* to be *Sebdenia flabellata*, causing terete plants of *Halymenia* from the USA, Bermuda and the Caribbean to be referred thereafter to *Halymenia trigona* (Clemente) G. Agardh. Terete *Halymenia* spp. world-wide have been found (Codomier, 1974; Millar, 1990) to be conspecific with *H.*

trigona, described from Atlantic Spain. Cremades & Perez-Cirera (1990: 490) indicated the correct name of *H. trigona* to be *Halymenia elongata* C. Agardh. Although Schneider & Searles (642: 282) stated that *H. elongata* (as *H. trigona*) can be easily distinguished from the similar *S. flabellata* (the latter bears obvious gland-like cells on inner medullary stellate ganglia; *H. elongata* has no gland-like cells), both taxa could have been involved in the establishment of these earlier western African records under *H. agardhii* and we have not attempted definitive allocation to either. Restrictions on time have prevented us from examining actual material involved.

Halymenia bermudensis Collins & Howe
Salvage Islands (38B; 556; 598).
Note. See Wynne (1986) on the authorities for this taxon. Schneider (1975) and Schneider & Searles (642: 277) cite the correct form as in this heading.

Halymenia capensis Montagne
Canaries (44; 401; 404).
Note. For possible attributions of these records, see entry for *Gymnophlaea canariensis* Kützing in Price *et al.*, 1988: 254.

Halymenia clavaeformis Suhr
Canaries (24; 44; 70; 134; 318; 401; 553; 616).
Note. Børgesen (70), De Toni (134) and Weber-van Bosse (553) all comment that specimens from Suhr in Herb. Montagne, Paris, are possibly representative of *Rhodymenia* [now *Palmaria*] *palmata* rather than *H. clavaeformis*.

Halymenia cyclocolpa Montagne
See *Platoma cyclocolpa* (Montagne) Schmitz.

Halymenia dichotoma (J. Agardh) J. Agardh
Canaries (70; 134; 188; 191; 227; 390).
[As *Halymenia dichotoma* J. Agardh]
'. . . mittelländischen Meer und in den angrenzenden Teilen des atlantischen Oceans' (510).
[As *Chrysymenia dichotoma* J.G. Agardh]
Canaries (259).
[As *Chrysymenia (Halichrysis) dichotoma* J. Agardh]
Canaries (24).
Note. Recorded with doubt by Hemsley (259). This taxon has been reallocated to the genus *Sebdenia* of Berthold; see Codomier (1973). In view of the confusions in previous records between and within both these genera, we have not attempted reallocation in the absence of opportunity to examine original material in confirmation of generic/specific placement.

Halymenia duchassaingii (J. Agardh) Kylin
Cameroun (350; 586).
Gabon (350;586).
'. . . Tropical Africa (N. Gambia—Congo river)' (598).
'. . . in tropical parts of the Atlantic Ocean' (350; 586).

Halymenia elongata C. Agardh
Canaries (635).
Sénégal (403; 408).
[As *Halymenia elongata* L. et Crouan]
Sénégal (38).
?Cape Verde Islands (38).
Note. Montagne (403: 125–126) commented: '. . . J'ai trouvé des tétraspores dans des exemplaires de l'*H. elongata* rapportés du Cap-Vert par M. Leprieur.'. Askenasy (38) later extended this by stating of *H. elongata*: '. . . n'ont pas été rapportées des îles du Cap Vert; il est très probable qu'elles y croissent aussi et qu'on les trouvera plus tard. . .'. The question mark above derives from Askenasy's statement. Conspecificity world-wide of terete *Halymenia* spp. (Millar, 1990) could result in records being reallocated here from various taxa. See the note to *Halymenia agardhii* De Toni.

Halymenia fasciata Bory de St. Vincent
Sénégal (282).

Halymenia floresia (Clemente) C. Agardh
Canaries (24; 33; 60; 70; 97; 102; 134; 177; 188; 191; 227; 350; 375; 390; 401; 517; 584; 586; 598; 635; 642).
Mauritanie (624).
Sierra Leone (30; 350; 586).
'. . . warmer parts of the Atlantic. . .' (60; 70; 375).
'. . . im wärmeren Teile des atlantischen Oceans, an den Küsten . . . Afrikas. . .' (510).
'. . . Ad oras . . . Africae borealis. . .' (318).
[As *Halymenia floresia* (Clemente) J. Agardh]
'. . . wärmeren Theilen des Atlantischen Oceans. . .' (266).
'. . . in oceano atlantico calidiore ad litora . . . Africae. . .' (27).
[As *Halymenia floresia* Agardh]
Canaries (44; 89; 256; 257).
'. . . De l'embouchure du Guadalquivir aux Canaries. . .' (89).
'. . . Atlantic (. . . Africa. . .)' (410).
'. . . Atlantic Ocean (. . . African . . . coasts. . .)' (177).
Note. Aleem (30) reported this species dredged from 30 m from the shelf of the Sierra Leone peninsula; Lawson & John (350; 586) repeated the record with doubt, since it then constituted the only precise West African mainland report. Borgesen's (60; 70) Canaries report was based on '. . . few small bleached fragments of this plant [in Montagne's Herb.] . . . most probably belong to this species'. Marcot-Coquengniot (624: 198) recently unequivocally reported *H. floresia* from subtidal wrecks at two locations in the Banc d'Arguin area of Mauritanie.

Halymenia floridana J. Agardh
Canaries (18; 598).
Note. For details of this difficult taxon, see Schneider & Searles (642: 279–280; comments on p. 339 are also useful).

Halymenia hancockii W. Taylor
Sénégal (38D; 59).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
Note. Also recently reported (38D) from Madeira.

Halymenia latifolia P. & H. Crouan in Lloyd ex Kützing
Canaries (70; 191; 226; 227; 584; 598).
'. . . Atlantique (de la Manche aux Canaries). . .' (188).
[As *Halymenia (Halarachnion) latifolia* Crouan]
Canaries (439).
Note. Piccone himself (439), the first to record this species, stated that he had a single sterile specimen and recorded it with grave doubt. Prud'homme van Reine (pers. comm.), on studying the original specimen, concluded that it represented *Halymenia vinacea* Howe & W.R. Taylor (q.v.). The entry is maintained here for completeness only, since the nature of the later Canaries records has not been established by re-examination of material.

Halymenia latifolia P. & H. Crouan f. **trabeculata** (Ercegovíc) Codomier
Canaries (643).
[As *Halymenia* (*Halarachnion*?) spp.]
Canaries (439).
Note. The reallocation of the record from 439 follows re-examination of material by Prud'homme van Reine (pers. comm.).

Halymenia ligulata (Woodward) C. Agardh
See *Halarachnion ligulatum* (Woodward) Kützing.

Halymenia pinnulata J. Agardh
See the note to *Chrysymenia dichotoma* J. Agardh.

Halymenia polydactyla Børgesen
See the note to *Halymenia agardhii* De Toni.

Halymenia ramosissima Suhr
See the note on *Agardhiella tenera* (J. Agardh) Schmitz [=*Solieria filiformis* (Kützing) Gabrielson].

Halymenia rosea Howe & W.R. Taylor
Canaries (635).

Halymenia senegalensis Bodard
Sénégal (55; 56; 59; 290; 399; 598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).

Halymenia trigona (Clemente) C. Agardh
See the note to *Halymenia agardhii* De Toni.

Halymenia vinacea Howe & W.R. Taylor
Canaries (635; 643).
Ghana (350; 586; 590).
'. . . in tropical parts of the Atlantic Ocean' (350; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).
Note. See remarks in 350, 586 and 642: 280. Possibly recorded as *Halymenia* sp. b. from Sénégal by Bodard (50); see below. See also the notes to *Halymenia latifolia* P. & H. Crouan for the early additional record given as 643.

Halymenia (Halarachnion?) spp.
Canaries (439).
Ghana (487).
Sénégal (50; 182).
Note. Bodard (50) reported two undetermined species of *Halymenia*, a and b. Regarding species b he remarked '. . . Par certains caractères elle rassemble à *Halymenia vinacea* Howe et Taylor'. The record in 439 from the Canaries is based on material recently re-examined by Prud'homme van Reine (643); he concluded that it represents *Halymenia latifolia* f. *trabeculata* (q.v.).

Hapalidium phyllactidium Kützing
See *Melobesia confervicola* (Kützing) Foslie.

Haraldia lenormandii (Derbès & Solier) J. Feldmann
Canaries (636).
Cape Verde Islands (637).

Haraldiophyllum bonnemaisonii (Greville) A. Zinova
Namibia (36B; as 'prox').
Note. Wynne's (36B: 321) use of 'prox.' indicates wide morphological variation between specimens that are apparently referable to this European Atlantic species; Wynne also indicated a tentative identification from Cape Peninsula (South Africa).

Helminthiopsis purpurifera (J. Agardh) Papenfuss
[As *Acrosymphyton purpuriferum* (J. Agardh) Sjöstedt]
Canaries (38C; 38D; 227; 232; 584; 628).

Helminthocladia calvadosii (Lamouroux ex Dufy) Setchell
Canaries (4; 8; 16; 128A; 172; 227; 232B; 379; 598).
Cape Verde Islands (598).
'. . . Atlantique (de l'Angleterre aux Canaries)' (33).
'de Inglaterra a Canarias' (619).
Note. See also *Helminthocladia senegalensis* Bodard.

Helminthocladia senegalensis Bodard
Sénégal (55; 57; 58; 59; 399; 598).
Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara] (598).

[As *Helminthocladia calvadosii* (Lamouroux) Setchell]
Sénégal (49; 50).

Helminthora divaricata (C. Agardh) J. Agardh
See *Helminthora stackhousei* (Clemente) Cremades & Perez-Cirera.

Helminthora stackhousei (Clemente) Cremades & Perez-Cirera
[As *Helminthora divaricata* (C. Agardh) J. Agardh]
Canaries (638).

Heringia mirabilis (C. Agardh) J. Agardh
Namibia (36B; 163; 348; 500; 515).

Herposiphonia
For general background to some aspects of specific level taxonomy and nomenclature in this widespread genus, see Wynne (36). Comments in Lawson & John (586) provide the necessary leads into much of the earlier literature, whilst the present listing updates subsequent taxonomic practice and publications for the area.

Herposiphonia brachyclados Pilger
Annobon (139; 350; 456; 457; 496; 586).
Ascension (475).
Note. De Toni (139: 420) considered this species and *H. tenella* [*H. secunda* f. *tenella*, q.v.] to be close.

Herposiphonia densa Pilger
See *Herposiphonia secunda* (C. Agardh) Falkenberg forma *densa* (Pilger) Wynne and *Herposiphonia guineensis* G. Lawson & D. John.

Herposiphonia guineensis G. Lawson & D. John
Côte d'Ivoire (350; 586).
Ghana (350; 586).
Liberia (350; 586).
Togo (350; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).
'. . . western Africa' (36).
[As *Herposiphonia densa* Pilger]
Côte d'Ivoire (287; 295).
Ghana (295; 297; 338; 537).
Liberia (287; 295).
Togo (293;295).

Herposiphonia heringii (Harvey) Falkenberg
Namibia (348).

Herposiphonia? parvula (Suhr ex Kützing) De Toni
Canaries (133).
[As *Polysiphonia parvula* (Suhr in herb. Sonder—*P. irregularis* Zanardini. ms].
Canaries (322).
Note. De Toni (133) placed this record under 'Species Polysiphoniae inquirendae, forsan ad genus Herposiphoniani pertinentes'.

Herposiphonia secunda (C. Agardh) Falkenberg
f. **secunda** (C. Agardh) Wynne
Canaries (604; 605).
Mauritanie (624).
[As *Herposiphonia secunda* (C. Agardh) Falkenberg]
Canaries (108; 604; 605).
Mauritanie (624)
'Ampliamente distribuida por los mares calidos y tropicales' (604).
[As *Herposiphonia secunda* (C. Agardh) Nägeli]

Cameroun (337; 537)
Canaries (16; 71; 174; 191; 225; 235; 375; 489; 517; 546; 547; 556; 610).
Cape Verde Islands (191).
Gambia (292).
Ghana (292).
Salvage Islands (215; 231; 375; 556).
Sénégal (556).
Sierra Leone (30).
'Mediterranean and adjacent warmer parts of the Atlantic . . . Probably widely spread in tropical and subtropical seas' (375).
'. . . pantropical. . .' (610).
[As *Herposiphonia secunda* (*Polysiphonia secunda*) Montagne]
Canaries (547).
[As *Herposiphonia secunda* (C. Agardh) Ambronn]
Canaries (13; 128A; 190; 226; 227; 229; 253; 306B; 379; 584).
Sénégal (59).
'. . . muy extendida por los mares tropicales y subtropicales' (253).
'Semble répandu dans toutes les mers tropicales et subtropicales' (190).
[As *Herposiphonia tenella* var. *secunda* Hollenberg]
Angola (352).
Cameroun (350).
Canaries (38B; 38C; 38D).
Ghana (350).
Mauritanie (349).
Salvage Islands (38B; 38C; 38D).
Sénégal (38B; 38C; 38D).
Sierra Leone (295; 349; 350).
[As *Herposiphonia tenella* forma *secunda* (C. Agardh) Hollenberg]
Canaries (392).
[As *Herposiphonia tenella* var. *subsecunda* Hollenberg]
Mauritanie (349).
[As *Polysiphonia secunda* Montagne]
Canaries (38; 44; 89).
Cape Verde Islands (38).
Sénégal (38).
[As *Polysiphonia secunda* (Agardh) Montagne]
Canaries (401; 439; 445).
Sénégal (408).
[As *Polysiphonia secunda* (Agardh) Montagne var. *Adunca* (Agardh) Montagne]
Canaries (401).
[As *Polysiphonia secunda* (Agardh) Zanardini]
Canaries (441; 444).

f. **tenella** (C. Agardh) Wynne
Canaries (602A; 604).
Mauritanie (624).
'Ampliamente distribuida por los mares cálidos y tropicales'(604).
[As *Herposiphonia tenella* (C. Agardh) Ambronn]
Angola (298; 352).
Ascension (474; 475).
Cameroun (350).
Canaries (13; 38B; 38C; 38D; 128A; 226; 227; 253; 306B; 379; 517; 557A; 584).
Gambia (296; 350).
Ghana (295; 338; 350; 377; 491).
Liberia (129; 295; 350).
Mauritanie (38B; 38C; 38D; 349).
Salvage Islands (38B; 38C; 38D)'
São Tomé (93; 350).
Sénégal (38B; 38C; 38D; 50; 122; 542).
Sierra Leone (30; 295; 350).
'. . . Atlantique tropicale et subtropicale. . .' (542).
'. . . Muy extendida por los mares tropicales y subtropicales. . .' (253).
'. . . probably widespread in warm temperate and tropical seas' (350).
'Semble répandu dans toutes les mers tropicales et subtropicales' (190).
'. . . world-wide . . . on tropical to warm temperate coasts. . .' (267A).
'. . .widespread in tropical and subtropical seas' (642).
[As *Herposiphonia tenella* (C. Agardh) Falkenberg]
Canaries (598).
Cape Verde Islands (598).
Salvage Islands (598).
'. . . atlantischen küsten von England bis zu den Canarischen Inseln. . .' (501).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'. . . Tropical Africa (N. Gambia—Congo river)' (598).
[As *Herposiphonia tenella* (C. Agardh) Schmitz]
Canaries (392).
[As *Herposiphonia tenella* (C. Agardh) Nägeli]
Canaries (16; 71; 108; 140; 174; 191; 225; 375; 390; 489; 555; 556).
Mauritanie (555; 556).
Salvage Islands (231; 555; 556).
São Tomé (93).
Sénégal (555; 556).
'. . . Atlantique (du golfe de Gascogne aux Canaries) . . . répandu dans les mers tropicales et sub-tropicales' (33).
'. . . Probably spread in tropical and subtropical waters' (375).
[As *Herposiphonia tenella*—Schmitz (*Polysiphonia tenella* J. Agardh)]
Canaries (547).
[As *Polysiphonia tenella* J. Agardh]
Canaries (89).

Note. On the status of this taxon as forma or variety of *H. secunda* (C. Agardh) Falkenberg, or as separate species, see Schneider & Searles (642).

f. **densa** (Pilger) Wynne
[As *Herposiphonia densa* Pilger]
Cameroun (122; 139; 288; 337; 350; 454; 500; 537).
Côte d'Ivoire (287; 288).
Ghana (288; 297).
Liberia (287; 288).
Sénégal (47; 55; 59; 122; 529).
Togo (288; 293).
'. . . l'aire se limite au golfe du Bénin et à la Mauritanie. . .' (59).
'. . . espèce ouest africaine' (59).
'. . . Espèce tropicale africaine' (529).
[As *Herposiphonia tenella* (C. Agardh) Ambronn var. *densa* (Pilger) G. Lawson & D. John]
Cameroun (350).

Herposiphonia spp.
Bioko (346; 350).
Canaries (71; 226).

Ghana (377; 487; 491).
Sénégal (59).
'West Africa' (290; 344).

Heteroderma lejolisii (Rosanoff) Foslie
See *Pneophyllum lejolisii* (Rosanoff) Chamberlain.

Heterosiphonia
Many red algal genera show little overlap in species names utilised in different but adjacent areas of the western Atlantic. *Heterosphonia* is such a genus, South Africa (Seagrief, 1984) showing records for five species of which none is recorded for the present list area, although the records to genus only for Namibia could perhaps represent one or more common taxa.

Heterosiphonia crispella (C. Agardh) Wynne
Canaries (36A; 598; 604; 605; 621).
Cape Verde Islands (598).
Ghana (586).
Mauritanie (624).
Salvage Islands (36A; 598).
'. . . ampliamente distribuida por los mares cálidos y tropicales' (604).
'. . . northwestern Africa . . . southward to tropical West Africa . . . and Angola' (36A).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]. . .' (598).
'Tropical Africa (N. Gambia—Congo River). . .' (598).
'. . . widespread from boreal-antiboreal to tropical seas' (586).
Note. For detailed reasoning behind the name change from *wurdemannii*, see Wynne (36A: 85–87). See also the entry (Price et al., 1986: 93) for *Fucus plumosus* L.

[As *Heterosiphonia crispella* (C. Agardh) Wynne var. *laxa* (Børgesen) Wynne]
Canaries (36A).
Salvage Islands (36A).
'. . .northwestern Africa . . . southward to tropical West Africa . . . and Angola. . .' (36A).
'West Africa' (642).
Note. Records above are based on those in 71 (Canaries), 535 (Salvage Islands) and 118, 119, 122, 298 and 350 (the generalized statement).

[As *Heterosiphonia wurdemannii* (Bailey ex Harvey) Falkenberg]
Angola (298; 352).
Ascension Island (475).
Canaries (13; 36A; 108; 226; 227; 292*; 392).
Ghana (292; 299; 350; 376; 377; 491).
Mauritanie (349).
Sénégal (292).
'Atlantic Ocean (Africa and American coasts, Canary Islands. . .)' (177).
'. . . widespread from boreal-antiboreal to tropical seas. . .' (350).
'. . . widespread occurrence in warm temperate and tropical seas. . .' (292).
Note. No attempt is made separately to distinguish records where the epithet *wurdemannii* is incorrectly rendered with a single 'i' or 'n'. The record indicated by an asterisk states the describing authority to be Bailey in Harvey. Material reported from Cap Blanc (Mauritania) was detected (349) only as drift.

[As *Heterosiphonia wurdemannii* (Bailey) Falkenberg]
Canaries (71; 128A; 174; 191; 306B; 375; 542; 555; 556).
Mauritanie (555; 556).
Salvage Islands (36A; 231; 375; 555; 556).
Sénégal (55; 59; 122; 186; 399; 542; 555; 556).
'. . . Atlantique (de Cadix aux Canaries. . .)' (190).
'. . . warm Atlantic' (78).
Note. No attempt is made separately to distinguish records where the epithet *wurdemannii* is incorrectly rendered with a single 'n' or 'i'.

[As *Heterosiphonia wurdemannii* (Bailey ex Harvey) Falkenberg var. *laxa* Børgesen]
Canaries (13; 38B; 71).
Mauritanie (38B; 349).
Salvage Islands (38B).
Sénégal (38B).
[As *Heterosiphonia wurdemannii* (Bailey ex Harvey) Falkenberg var. *typica* Børgesen]
Canaries (38B; 38C; 38D; 71; 226).
Mauritanie (38B*; 38C; 38D).
Salvage Islands (38B; 38C; 38D).
Sénégal (38B*; 38C; 38D).
Note. No attempt is made separately to distinguish records where the specific (not varietal) epithet *wurdemannii* is incorrectly rendered with a single 'i' or 'n'. Records indicated by an asterisk state 'var. *typica* Piccone', thereby differing from the usual authority statement.

[As *Dasya wurdemanni* Bailey]
Canaries (439; 547).
[As *Dasya wurdemanni* Bailey in Harvey]
Canaries (89).

Heterosiphonia dubia (Suhr) Falkenberg
Namibia (36B).

Heterosiphonia pellucida (Harvey) Falkenberg
Canaries (303).
Note. No authority is given by Johnston (303); conspecificity of material is therefore conjectural.

Heterosiphonia plumosa (Ellis) Batters
Western Sahara (33; 222; 349).
Note. Overall distribution statements in 33 and 222 give the southern limit as 'Rio de Oro'.

Heterosiphonia wurdemannii (Bailey ex Harvey) Falkenberg and other variants
See *Heterosiphonia crispella* (C. Agardh) Wynne.

Heterosiphonia sp.
Namibia (348).
Note. See the generic note for possible specific relationships.

Hildenbrandia canariensis Børgesen
Canaries (33; 39; 70; 191; 227; 598; 627).
Mauritanie (33; 349; 598; 627).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).

Hildenbrandia prototypus Nardo
See *Hildenbrandia rubra* (Sommerfelt) Meneghini.

Hildenbrandia rosea Kützing
See *Hildenbrandia rubra* (Sommerfelt) Meneghini.

Hildenbrandia rubra (Sommerfelt) Meneghini
Ascension (475).
Canaries (227; 598).
Côte d'Ivoire (350; 586).

Gambia (296; 350; 586).
Ghana (350; 586).
Liberia (350; 586).
São Tomé (350; 586).
Sierra Leone (350; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).
[As *Hildenbrandia prototypus* Nardo]
Angola (298; 352).
Canaries (70; 191; 493; 517).
Côte d'Ivoire (288).
Gambia (288).
Ghana (288; 340; 344).
Liberia (129; 288).
São Tomé (288).
Sierra Leone (30; 288; 295).
'. . . Atlantique (du Spitzberg aux Canaries. . .)' (33).
'. . . most probably ubiquitous. . .' (61).
'Probably cosmopolitan' (375).
[As *Hildenbrandia rosea* Kützing]
Namibia (348).
São Tomé (263; 264; 265; 535).
[As *Hildenbrandia* sp.]
São Tomé (535).

Note. Although Henriques (264) reported the material from São Tomé as doubtfully determined since sterile, he still named it *H. rosea* (263; 264; 265). Steentoft (535), faced with similar problems, preferred to avoid allocation of epithet.

Hildenbrandia spp.
Ghana (342).
Namibia (348).
São Tomé (535).

Note. For the probable allocation of records in 348 and 535, see the note to *H. rubra* (Sommerfelt) Meneghini.

Hutchinsia filamentosa (Wulfen) C. Agardh
See *Spyridia filamentosa* (Wulfen) Harvey.

Hydrolithon

We are indebted to Wm. J. Woelkerling for the following comments.

Studies of Penrose & Woelkerling (1992) on *Hydrolithon reinboldii*, the type species of *Hydrolithon*, have resulted in a revised circumscription for the genus in which attributes associated with tetrasporangial conceptacle roof anatomy are crucial. Thus *Hydrolithon* is delimited from other genera of the Corallinaceae by the following combination of features:

1. thallus nongeniculate, nonendophytic and lacking haustoria;
2. thallus lacking a basal layer of palisade cells throughout;
3. cells of adjacent filaments joined by cell fusions, secondary pit-connections absent;
4. tetrasporangial conceptacles uniporate and tetrasporangia lacking apical plugs; and
5. pore canals of tetrasporangial conceptacles lined by a ring of conspicuous, elongated cells which arise from filaments interspersed amongst sporangial initials, which do not protrude into the pore canal and which are orientated more or less perpendicular to the roof surface.

Penrose & Woelkerling (1992) also have determined that *Porolithon* is a heterotypic synonym of *Hydrolithon*. Distinctions between *Hydrolithon* and *Spongites* are outlined by Penrose & Woelkerling (1992), and a detailed study of the type species of *Spongites* is provided by Penrose (1991).

Hydrolithon boergesenii (Foslie) Foslie
São Tomé (350; 586).
'. . . in warm temperate and tropical parts of the Atlantic Ocean' (350; 586).
'. . . Tropical Africa (N. Gambia—Congo river)' (598).
[As *Goniolithon boergesenii*]
São Tomé (6).
[As *Goniolithon Boergesenii* Foslie forma *africana* Foslie]
São Tomé (206).
[As *Goniolithon Boergesenii* Foslie var. *africana* Foslie]
São Tomé (135; 136; 485).
[As *Goniolithon (Hydrolithon) Boergesenii* Foslie forma *africana* Foslie]
São Tomé (135, 206).
'Coste occid. d'Africa, S. Thomas (Gravier)' (135).
[As *Goniolithon (Hydrolithon) Boergesenii* Foslie var. *africana* Foslie]
São Tomé (136; 137; 206; 251)
[As *Porolithon Boergesenii* (Foslie) Lemoine forma *africana* Foslie]
São Tomé (139).
[As *Porolithon Boergesenii* (Foslie) Lemoine var. *africana*]
São Tomé (357).
[As *Porolithon Boergesenii* (Foslie) Lemoine]
São Tomé (139; 357; 358; 535).

Note. Foslie (206) based his St. Thomas (Africa) record on Gravier collection no. 6, communicated by P. Hariot. Similarly, the determination given in Hariot (251) relates to the same Gravier material and is stated to be by Foslie. Lemoine (357: 149) indicated that she could add nothing to the picture of this variety as envisaged by Foslie. The specimen she examined in Paris of 'type' material of the var. *africana* was so small that to study it was to destroy it—she did not know if Foslie had a better specimen. In their entry on *Hydrolithon reinboldii* (Weber-van Bosse & Foslie) Foslie, Adey *et al.* (1982: 26) commented of the two species: '. . . The Caribbean *Hydrolithon borgesenii* (Foslie) Foslie is quite similar to *H. reinboldii* in color, surface texture, and anatomy, though it is not usually so strongly mammillate as the Hawaian plant. Also, *H. borgesenii* has a very wide depth range and, in the Caribbean, appears to be the ecological equivalent of all of the Pacific *Hydrolithon* species'. Woelkerling (in litt.) has kindly confirmed that the type of *H. boergesenii* (Foslie) Foslie belongs to *Hydrolithon* sensu Penrose & Woelkerling (1992). The taxonomic placement of the forma *africana* is not yet certain.

Hydropuntia dentata (J. Agardh) Wynne
Cape Verde Islands (639).
Mauritanie (624).

Note. Wynne (1989) has reinstated the genus *Hydropuntia* Montagne to include species of *Polycavernosa*; see *Gracilaria* [=*Polycavernosa*] *dentata* for comments appropriate at the time (Price *et al.* 1988). Since then, and subsequent to Wynne (1989), Abbott *et al.* (1991: 24) have reassessed assignment to *Hydropuntia* of both *H. dentata* and *H. henriquesiana* in the process of arriving at their conclusion that there is little to warrant continued recognition of *Hydropuntia* (=*Polycavernosa*) and *Gracilariopsis*. If their reasoning, and consequent reassignments, are accepted, both taxa (*H. dentata*, *H. henriquesiana*) become synonyms of *Gracilaria rangiferina* (Kützing) Piccone. We make no definitive moves in any direction at this time since restoration to *Gracilaria* by Abbott *et al.* (*op. cit.*) was purely based on previous assignment, not on re-examination of appropriate material.

Hydropuntia henriquesiana (Hariot) Wynne

Note. See (a) the comments and records under *Gracilaria* [=*Polycavernosa*] *dentata* in Price *et al.* (1988), and (particularly) (b) the detailed note to *Hydropuntia dentata* (J. Agardh) Wynne, above.

Hymenena fissa Greville
See *Hymenena venosa* (L.) Kylin.

Hymenena venosa (L.) Kylin
Namibia (348).
[As *Hymenena fissa* Greville]
Sénégal (38; 408).
Note. Both citations derive from the island of Gorée. Askenasy (38) also indicated that plants representative of this taxon '. . . n'ont pas été rapportées des îles du Cap Vert; il est très probable qu'elles y croissent aussi et qu'on les trouvera plus tard'.

[As *Nitophyllum venosum* Harvey]
Namibia (165; 500).
Note. Dinter (165: 315) recorded the taxon from Walfischbay, collected by Cleverley, and the Schmidt & Gerloff (500) statement is merely based on that.

[As *Nitophyllum fissum* (Greville) J. Agardh]
Namibia (165; 453).
Note. Dinter (165: 315) recorded the taxon from Lüderitzbucht, collected by L. Scholtz, a direct derivation from the Pilger (453) statement.

Overall Note. The epithets *fissa* and *venosa* are now generally accepted to apply to the same plant in this area of the Atlantic (see, for example, Seagrief, 1984). It remains to be established that the determinations in all the records quoted were correct. A record quoted for the Canaries (598) under the name *Nitophyllum venulosum* may have been a mis-statement of epithet for the same taxon; no authorities are listed and the determination needs confirmation since this represents the only record for that island group. The relationship of the records under *Hymenena* sp. (q.v.) to *H. venosa* is not clear.

Hymenena sp.
Ghana (290; 299; 300; 350; 376; 377; 586).
Note. See the terminal note to *Hymenena venosa* (Linnaeus) Kylin.

Hypnea
This complex genus has a confused nomenclatural history. Additionally, both biology and relation of form-variation to environment are still poorly understood. All this has resulted in a taxonomic and recording mosaic, the resolution of which really requires monographic treatment on a world scale. Since the genus is of substantial commercial (phycocolloid) importance, there is considerable literature, much of it concerned with aspects other than taxonomy and biology; the general effect has been further to complicate the taxonomic situation. Commercial data and literature sources appear in Hoppe (269: 253–255) and in Rama Rao (481), both of which also include primary and secondary distributional data for parts of the list area. More recent papers concerned directly with part (Sénégal) of the area are those of Mollion (398; 399; 623). An earlier taxonomic coverage by Bodard (53), although valuable, includes many errors of taxonomy and faulty interpretation of distributional and other data.

Hypnea arbuscula P. Dangeard
Canaries (635; 640).
Cape Verde Islands (640).
Gambia (296; 350; 586).
Guinea-Bissau (529).
Mauritanie (624).
Sénégal (53; 55; 56; 59; 122; 529).
'. . . in warm temperate and tropical parts of West Africa' (350; 586).
'. . . Tropical Africa (N.Gambia—Congo river)' (598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).

Hypnea benguelensis Palminha
Angola (241; 352; 393; 394; 424; 428).

Hypnea cenomyce J. Agardh
Cape Verde Islands (637; 640).
Sierra Leone (53; 295; 350; 586).
Sénégal (53; 122; 350; 586).
'. . . doit être largement diffusée sur les côtes du golfe du Benin. . .' (53).
'. . . in warm temperate and tropical parts of West Africa. . .' (350; 586).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'Tropical Africa (N. Gambia—Congo river)' (598).
[As *Hypnea cenomyces* J. Agardh]
Sénégal (59).
[As *Hypnea ctenamyces* J. Agardh]
Sénégal (55).
[As *Hypnea ctenomyces* J. Agardh]
Sénégal (53; 122; 535).
Note. The record in 122 is given with '?'. Several of the authors (e.g. Bodard, 53; Steentoft, 535) have suggested this to be the same as a small *Hypnea spinella* (C. Agardh) Kützing (q.v.).

Hypnea ceramioides Kützing
Sénégal (59; 348; 399).
Mauritanie (53; 349).
Namibia (348; 438).
'Subtropical Africa [Sénégal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
[As *Hypnea* sp. aff. *ceramioides*]
Sénégal (53; 398).
[As *Hypnea* aff. *ceramioides* Bod. (nomen)]
Sénégal (55)
[As *Hypnea ceramoides* Kützing]
Sénégal (59; 480).
[As *Hypnea* aff. *ceramoides* Bodard (nomen)]
Sénégal (59; 399).
[As *Hypnea veramoides*]
Sénégal (481).

Hypnea cervicornis J. Agardh
See *Hypnea spinella* (J. Agardh) J. Agardh.

Hypnea cornuta (Lamouroux) J. Agardh
See *Hypnea valentiae* (Turner) Montagne.

Hypnea ctenomyces J. Agardh
Note. See *Hypnea cenomyce* J. Agardh, for which this name represents a mis-rendering of the specific epithet.

Hypnea divaricata Greville
Cape Verde Islands (38; 145; 450; 451; 500; 598; 625).

Hypnea eckloni Suhr
See *Hypnea musciformis* (Wulfen) Lamouroux.

Hypnea esperi Bory, (Bory) Kützing, or Kützing
See *Hypnea musciformis* (Wulfen) Lamouroux.

Hypnea flagelliformis Greville ex J. Agardh
[As *Hypnea flagelliformis* (Greville) J. Agardh]
Canaries (640).
Cape Verde Islands (640).
Côte d'Ivoire (59; 586).

Ghana (59; 291; 350; 586).
Guinea-Bissau (529).
Liberia (129).
Mauritanie (53; 296).
Sénégal (53; 59; 122?; 296; 529).
'. . . golfe du Benin. . .' (59).
'Pantropical' (529).
'Tropical Africa (N. Gambia—Congo river)' (598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).

Hypnea musciformis (Wulfen) Lamouroux
Angola (213; 269; 352; 500; 535).
Cameroun (213; 269; 295; 337; 350; 454; 484; 500; 535; 537; 586).
Canaries (5; 13; 16; 25; 38B; 38C; 38D; 70; 71; 89; 108; 128A; 132; 147?; 148?; 191; 213; 226; 227; 230; 235; 236; 238; 252; 267A; 302; 306B; 351; 379; 392; 401; 404; 439; 489; 490; 499; 517; 535; 556; 584; 598; 604; 605; 610; 621).
Cape Verde Islands (38B; 38C; 38D; 100; 183; 191; 213; 252; 267A; 408; 423; 442; 443; 445; 446; 449; 483; 499; 535; 556; 598).
Congo (535).
Côte d'Ivoire (287; 288; 350; 586).
Gabon (294; 350; 586).
Gambia (296; 350; 586).
Ghana (213; 288; 291; 335; 338; 340; 344; 350; 393; 394; 409; 481; 487; 491; 535; 537; 586; 594).
Guinea-Bissau (529?).
Liberia (129; 287; 295; 350; 586).
Mauritanie (38B; 38C; 38D; 53; 252; 267A; 269; 349; 481; 516; 535; 556; 624).
Namibia (36B; 348).
Nigeria (213; 285; 350; 535; 586).
Princípe (93; 350; 535; 586).
Salvage Islands (38B; 375; 555).
São Tomé (213; 251; 261; 265; 295; 350; 535; 586).
Sénégal (38B; 38C; 38D; 50; 51; 53; 55; 56; 59; 99; 122; 182; 213; 252; 267A; 291; 350; 394; 398; 399; 411; 480; 481; 529; 542; 556; 586; 618; 623).
Sierra Leone (30; 213; 295; 336; 350; 535; 586).
Togo (293; 295; 350; 586).
Western Sahara (38B; 38C; 38D).
'. . . allen wärmeren Meeren. . .' (482; 483).
'Ampliamente distribuida por los mares cálidos y tropicales' (604).
'. . . Atlantique tropical et Subtropical. . .'(184; 189).
'. . . im wärmeren atlantischen . . . Ocean. . .' (506).
'. . . Du Golf de Gascogne aux Canaries' (38; 89).
'Gulf of Guinea' (480).
'Gulf of Givea [sic!]' (481).
'Pantropical' (529; 610).
'seems to occur in all warmer seas. . .' (64; 70).
'. . . Tropical and subtropical Atlantic. . .' (375).
'. . . toutes les mers tropicales et subtropicales' (542).
'Tropical Africa (N. Gambia—Congo river)' (598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'Warm Atlantic' (410).
'Widespread in warmer waters' (535).
'Widespread in warm temperate and tropical seas' (350; 586).
[As *Hypnea eckloni* (Suhr)]
Namibia (128; 164).
[As *Hypnea esperi* (Bory) Kützing]
Cape Verde Islands (38).
[As *Hypnea musciformis* Greville]
Sénégal (282).
[As *Hypnea musciformis* J. Agardh]
Angola (41; 42).
Canaries (44; 547).
Cape Verde Islands (38; 41; 42; 446; 596).
Congo (249;250).
Gabon (250).
Salvage Islands (231).
São Tomé (263; 264).
[As *Hypnea musciformis* Lamouroux]
Canaries (385).
[As *Hypnea musciformis* Lamouroux var. *esperi* (Bory) Montagne]
Cape Verde Islands (38; 408).
[As *Hypnea musciformis* (Wulfen in Jacquin) J. Agardh]
'. . . In oceano calidiore atlantico. . .' (27).
Note. See Schneider & Searles (642: 308–9) on the potentiality for confusion between this taxon and *H. valentiae* (Turner) Montagne.

Hypnea pannosa J. Agardh
Cape Verde Islands (38; 145; 450; 451; 500; 598).
Sénégal (53; 122; 535).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
Note. The comment (see note to *H. spinella* (C. Agardh) Kützing) on genomic distinction possibly applies equally between *H. pannosa* and *H. cervicornis*.

Hypnea setacea Kützing
See *Hypnea unilateralis* P. Dangeard.

Hypnea spicifera (Suhr) Harvey
Namibia (312A; 348; 437; 438; 523).

Hypnea spinella (C. Agardh) J. Agardh
St. Helena (644)
[As *Hypnea spinella* (C. Agardh) Kützing]
Angola (352).
Annobon (456; 457; 535).
Ascension (474; 475).
Canaries (13; 118; 128A; 226; 227; 232B; 253; 306B; 535; 602A; 604; 605).
Cape Verde Islands (38; 100; 183; 191; 264?; 440; 442; 443; 445; 446; 528; 535?).
Gabon (253; 295; 350; 586).
Gambia (296; 350).
Ghana (350; 491; 586).
São Tomé (251; 263?; 264?; 265; 350; 535; 586).
Sénégal (53; 535?).
Sierra Leone (30; 295; 336; 339; 350; 378; 535; 586).
Western Sahara (349).
'Ampliamente distribuida por los mares cálidos y tropicales' (604).
'. . . Atlántico (Canarias-Gabon . . .)' (253).
'. . . widespread in warm temperate and tropical seas' (350; 586).
'. . . widely distributed on the Atlantic coast of Africa' (535).
[As *Hypnea spinella* Kützing]
São Tomé (263; 264).
[As *Hypnea cervicornis* J. Agardh]
Angola (352).
Canaries (8; 13; 16; 38B; 38C; 38D; 70; 108; 128A; 191; 226; 227; 229; 233; 236; 237; 253A; 306B; 375; 535; 556; 584; 598; 604; 605; 610; 621).

Cape Verde Islands (1; 38; 38B; 38D; 150; 500; 556; 598).
Gabon (295; 350; 586).
Gambia (296; 350; 586).
Ghana (288; 290; 299; 300; 335; 338; 350; 376; 377; 491; 537; 586).
Liberia (129; 288; 350; 586).
Mauritanie (38B; 38C; 38D; 53; 349; 556; 624).
Princípe (93; 288; 350; 535; 586).
Salvage Islands (38B; 38C; 38D; 375; 556; 598).
São Tomé (288; 350; 535; 586).
Sénégal (38B; 38C; 38D; 49; 53; 56; 59; 122; 290; 350; 398; 399; 480; 481; 535; 542; 556; 586).
Sierra Leone (295; 350; 586).
Western Sahara (38B).
'Ampliamente distribuida por los mares cálidos y tropicales' (604).
'. . . most warm seas' (64; 70).
'. . . pantropical. . .' (610).
'Gulf of Guinea' (269).
'Tropical Atlantic' (544).
'. . . largement connu de l'Atlantique tropical. . .' (53).
'. . . largement connue en milieu tropicale. . .' (56).
'Tropical Africa (N. Gambia—Congo river)' (598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'West Africa' (615).
'. . . widespread in tropical and subtropical seas' (642).
[As *Hypnea cervicoris* (Turner) J. Agardh]
Sénégal (55).
[As *Hypnea cervicornis* C. Agardh]
Canaries (602A).
[As *Hypnea musciformis*]
São Tomé (251; 261; 263; 264; 265).
[As *Hypnea spinella* J. Agardh]
Cape Verde Islands (528).

Note. See also *Hypnea ctenomyces* J. Agardh. Analysis of the respective genomes may be the surest way to resolve the question of whether or not *H. spinella* and *H. cervicornis* (q.v.) are conspecific. Haroun & Prud'homme van Reine (640 and in press) have presented detailed discussion on both nomenclatural background and distribution, concluding that *H. spinella* and *H. cervicornis* are transitional forms resulting from the effects of habitat on the same genome. Pending genomic analysis, we have accepted their discussion and typification.

Hypnea ?tenuis Kylin
Namibia (348).

Note. Recorded from the Cunene River mouth, Angola/Namibia border; otherwise known from east coast of southern Africa.

Hypnea unilateralis P. Dangeard
Mauritanie (53; 349; 598).
Sénégal (53; 55; 56; 59; 122; 598).
Western Sahara (53; 349; 598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'. . . vraisemblable que cette espèce existe dans tout l'Atlantique tropical' (53).

Note. Bodard (53: 812) commenting on the *Hypnea* spp. given by Dangeard (122) for 'presqu'île du Cap-Vert (Sénégal)', said of *H. unilateralis* 'sp. nov.' 'Toutefois nous doutons de l'originalité de cette espèce, il pourrait bien s'agit en fait de l'*Hypnea setacea* Kützing, quoique cette dernière espèce soit très mal connue et toujours accompagnée . . . d'un?. . .'.

Hypnea ustulata (Mertens ex Turner) Montagne
See *Caulacanthus ustulatus* (Turner) Kützing.

Hypnea valentiae (Turner) Montagne
Canaries (25; 132; 401; 404; 407; 598).
Cape Verde Islands (640).
Ghana (350; 586).
Guinée (350; 586).
'. . . widespread in warm temperate and tropical seas' (350; 586).
'. . . widespread in tropical and subtropical seas' (642).
[As *Hypnea valentinae*]
Canaries (598).
'Tropical Africa (N. Gambia—Congo river)' (598).
[As *Hypnea cornuta* (Lamouroux) J. Agardh]
Canaries (128A; 306B; 582; 598).
'Guinea' [probably Ghana—see note below] (25; 64; 97; 132).
Sénégal (542).
São Tomé (132).
'. . . In atlantico calidiore. . .' (27).
[As *Hypnea cornuta* var. *cornuta* J. Agardh]
'. . . in oceano atlantico calidiore, ad oras Guineae. . .' (25).

Note. Børgesen (64) stated: 'St. Thomas: in the harbour of Charlotte Amalia . . . Orsted has gathered it at St. Thomas'. Therefore all records of this plant from St. Thomas refer to the West Indian island, not that in the Gulf of Guinea. Nevertheless, Børgesen mentioned it from Guinea, probably direct attribution of 'ad oras Guineae' in J. Agardh (1852) and De Toni (1900). In the time of Lamouroux, whose herbarium specimen is the source of these records, 'Guineae' referred to what is now Ghana. The references to *H. cornuta* are secondary records in Lawson & John's (586) entry for *H. valentiae*; they come from the same publications and should all be localised to Ghana, not to Guinée as stated. See also the note to *Hypnea musciformis* (Wulfen) Lamouroux.

Hypnea spp.
Angola (352).
Canaries (2; 5; 351).
Côte d'Ivoire (287).
Gambia (296).
Ghana (92; 291; 335; 344; 491; 567; 626).
Liberia (287).
Mauritanie (53; 349).
Namibia (348).
Sénégal (50; 52; 53; 55; 56; 59; 182; 290; 396; 398; 399; 411; 481; 531; 615).
'. . . African west coast. . .' (374).
'West Africa' (344; 615).

Hypneocolax stellaris Børgesen
Canaries (640).
Cape Verde Islands (640).

Hypoglossum
For an analysis of morphological distinctions between the sometimes confused forms in the genera *Caloglossa* and *Hypoglossum*, see Wynne & Kraft (561A). There is growing literature on the family Delesseriaceae in southern Africa to which effective entry can be made through the recent paper by Wynne & Norris (1991).

Hypoglossum abyssicolum W.R. Taylor
Angola (352).

Hypoglossum guineense G. Lawson & D. John
Ghana (350; 377; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).

[As *Hypoglossum* sp.]
Ghana (300; 376).

Hypoglossum hypoglossoides (Stackhouse) Collins & Hervey
Canaries (128A; 306B; 598; 604; 605; 621; 642).
Cape Verde Islands (598).
Salvage Islands (598).
'Gran Bretaña—Rio de Oro' (604).
'Subtropical Africa [Sénégal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
[As *Delesseria hypoglossum* Agardh]
Canaries (254; 257; 305).
[As *Delesseria Hypoglossum* Goodenough & Woodward) Lamouroux]
'. . . D'Angleterre aux Canaries. . .' (89).
[As *Delesseria hypoglossum* (Woodward) Lamouroux]
Canaries (25; 44; 401; 547).
[As *Hypoglossum woodwardii* Kützing]
Canaries (13; 38B; 38D; 71; 132; 191; 221; 226; 227; 232B; 238; 304; 375; 379; 392; 489; 517; 565A; 584; 617; 619).
Mauritanie (38B; 38D).
Salvage Islands (38B; 38D).
Sénégal (38B; 38D; 55; 59; 122; 399; 529).
Western Sahara (349; 565A; 618).
[As *Hypoglossum woodwardii* Kylin]
Mauritanie (516).
'Atlantischen Inseln' (239).
'. . . Atlantique nord et subtropical' (190).
'. . . Atlantique: depuis les côtes anglaises jusqu'au Rio de Oro. . .' (222).
'. . . Atlantic ocean (from England to the Canary Islands, . . .)' (177).
'. . . Atlantique (de l'Angleterre au Rio de Oro). . .' (33).
'. . . Atlantique: côtes d'Europe jusqu'aux Canaries. . .' (221).
'. . . Atlantico de Inglaterra a Canarias. . .' (517).
'. . . de Inglaterra a Rio de Oro' (619).
'. . . English coast southwards to the Canary Islands. . .' (71).
'. . . Im Atlantischen Ozean von den englischen küsten bis zu den kanaren. . .' (495).
'. . . in oceano Atlantico ab oris Angliae usque ad Tingin Africae et insulas Canarienses. . .' (132).

Hypoglossum woodwardii Kützing
See *Hypoglossum hypoglossoides* (Stackhouse) Collins & Hervey.

Hypoglossum spp.
Ghana (299; 300; 376; 491).
Namibia (348).
Sénégal (50; 55; 59; 542).
'. . . ouest africaines. . .' (59).
Note. Bodard & Mollion (59: 201) referred to this *Hypoglossum* sp. as '. . . est à décrire. . .'.

Iridaea capensis J. Agardh
Angola (352).
Namibia (36B; 348; 352; 437; 523; 595).

Iridaea elongata Suhr
'Table Bay to Walfisch Bay' (128).
Note. Possibly a synonym for *I. capensis*.

Janczewskia verrucaeformis Solms-Laubach
Canaries (71; 190; 191; 227; 232B; 375; 379; 598).
Cape Verde Islands (598).
Salvage Islands (38B; 231; 375; 598).
'. . . Atlantique (. . . Canaries). . .' (33).
Note. On *Janczewskia* in general, see Apt (1987).

Jania
The genus is more closely related to *Haliptilon* than it is to *Corallina* (Johansen, 1981; Johansen & Silva, 1978; Johansen & Womersley, 1986: 562). The taxonomic boundaries between *Haliptilon* and *Jania* are of different clarity in different parts of the world (Johansen & Womersley, 1986: 562); in southern Australia, they are very clear, whereas elsewhere (e.g. Europe) there are problems. There, *Jania corniculata* (Linnaeus) Lamouroux (q.v.) has lateral branches reminiscent of *Haliptilon*.

Jania adhaerens Lamouroux
Canaries (9; 13; 38B; 38C; 38D; 128A; 227; 306B; 379; 556; 582; 584; 598; 602; 604; 605).
Cameroun (122; 350; 500; 586).
Cape Verde Islands (598).
Gambia (296; 350; 586).
Ghana (350; 376; 377; 586).
Liberia (129).
Mauritanie (38B; 38C; 38D; 349; 556; 624).
Salvage Islands (38B; 38C; 38D; 556; 598).
São Tomé (93; 350; 535; 586).
Sénégal (38B; 38C; 38D; 122; 556).
Sierra Leone (30; 295; 349; 350; 586).
St Helena (644).
'Gulf of Guinea' (582; 604).
'. . . more or less pantropical. . .' (535).
'Tropical Africa (N. Gambia—Congo river' (598).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'. . . widespread in warm temperate and tropical seas' (350; 586).
'. . . widespread in tropical and subtropical seas' (642).
[As *Jania* sp. (*J. adhaerens* Lamouroux?)]
Sénégal (529).
'Atlantique tropicale' (529).
[As *Corallina adhaerens* (Lamouroux) Kützing]
Cameroun (454; 500).

Jania capillacea Harvey
Ascension (475).
Canaries (38B; 38D; 38C; 555; 556; 598; 602; 621).
Cape Verde Islands (38B; 38C; 38D; 100; 183; 191; 555; 556).
Gabon (294; 350; 586).
Ghana (377; 586).
Mauritanie (38C; 624).
Salvage Islands (38B; 38C; 38D; 555; 556; 598).
'. . . in tropical parts of the Atlantic and Pacific Oceans' (350; 586).
'. . . widespread in tropical and subtropical seas' (642).
[As *Jania capillacea* Lamouroux]
Canaries (18; 582).
Gulf of Guinea (582).

Jania corniculata (Linnaeus) Lamouroux
Canaries (38D; 227; 582; 584; 602).
Salvage Islands (598).
Note. For an additional Canaries record possibly attributable here, see *Jania rubens* (Linnaeus) Lamouroux f. *corniculata*.

Jania crassa Lamouroux
Angola (352; 541).
Cape Verde Islands (641).
Côte d'Ivoire (295; 350; 586).
Gabon (295; 350; 586).
Ghana (295; 350; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).
'widespread in warm temperate and tropical seas' (350; 586).
[As *Jania natalensis* Harvey]
Gabon (498; 535).
Ghana (338; 537; 541).
'. . . Westafrika (Gabun) bis zum Kap der Guten Hoffung' (498; 499; 535).

Jania cubensis Montagne ex Kützing
See *Haliptilon cubensis* (Montagne ex Kützing) Garbary & Johansen.

Jania fastigiata Harvey
See *Jania verrucosa* Lamouroux.

Jania granifera Decaisne
See *Corallina granifera* Ellis & Solander and *Haliptilon virgatum* (Zanardini) Garbary & Johansen.

Jania longifurca Zanardini
Congo (249; 250; 350; 586).
Mauritanie (252; 349; 359).
Sénégal (252).
'Atlántico (desde la costa vasca a Mauritania)' (517).
'. . . Atlantique (de la côte basque à la Mauritanie)' (188).
'. . . Subtropical Africa [Senegal (N. of Gambia); Mauritania, Former W. Sahara]' (598).
[As *Corallina (Jania) longifurca*]
Congo (535).

Jania micrarthrodia Lamouroux
Canaries (541).
Note. It has not been possible to locate authenticating material for this record.

Jania natalensis Harvey
See *Jania crassa* Lamouroux.

Jania pumila Lamouroux
Ascension (474).
Canaries (5; 16; 70; 71; 191; 227; 235; 238; 375; 582; 598; 602; 610).
St Helena (541).
Salvage Islands (38B; 231; 375).
'. . . pantropical. . .' (610).
Note. No authenticating material can be traced for the record presented in 541 (St Helena). Determination of Canaries material reported in 602 was provisional since the reduced-size plants lacked sufficiently definitive and well-documented characteristics, a situation common to all species in the genus (see 602: 20).

Jania rubens (Linnaeus) Lamouroux
Ascension (37; 474; 475).
Cameroun (213; 350; 454; 500; 586).
Canaries (2; 5; 8; 9; 13; 16; 38D; 70; 108; 128A; 175; 191; 213; 225; 226; 227; 228; 229; 230; 236; 237; 238; 252; 302; 304; 306B; 351; 356; 359; 379; 386; 392; 414; 439; 489; 490; 517; 546; 548; 556; 582; 584; 594; 598; 602; 604; 605; 610; 621).
Cape Verde Islands (37; 38D; 213; 252; 441; 556; 598; 620).
Gambia (296; 350; 586).
Ghana (299; 300; 338; 340; 344; 350; 376; 377; 491; 567; 586).
Mauritanie (38D; 252; 349; 359; 556; 624).
Nigeria (213; 350; 586).
Salvage Islands (38B; 38D; 231; 375; 556; 598).
São Tomé (350; 535; 586;).
Sénégal (38D; 59; 213; 556).
'Subtropical Africa [Senegal (N. of Gambia); Mauritania; Former W. Sahara]' (598).
'Tropical Africa (N. Gambia—Congo river)' (598).
'Atlantique depuis la Norvège jusqu'au littoral de l'Afrique du Nord et les Canaries; sud de l'Afrique' (356).
'. . . Atlantique: des côtes anglaises à la Mauritanie. . .' (222).
'. . . Atlantic Ocean (European, African and American coasts, Canary Islands. . .)' (177).
'. . . Atlantic coast from Norway to the Canary Islands. . .' (70).
'. . . Atlantico de Noruega a las islas Canarias. . .' (517).
'. . . Atlantique (de la Norvège à la Mauritanie, Canaries. . .)' (33).
'Atlantico (de Noruega a Mauritania. . .)' (620).
'Gulf of Guinea' (582).
'. . . widespread in warm temperate and tropical seas' (350; 586).
'. . . widespread in warm temperate to subtropical seas' (642).
'. . . cosmopolite. . .' (59).
[As *Corallina rubens* Ellis & Solander]
Canaries (236).
Note. The juxtaposition of records under both *Jania rubens* and *Corallina rubens* Ellis & Solander in 236 may imply that female material recorded as *C. rubens* represented a different taxon. Nomenclatural attribution suggests both are the same species.

[As *Corallina rubens* Linnaeus]
Cameroun (239; 454).
Cape Verde Islands (483).
'. . . allen wärmaren Meeren' (483).
'An der afrikanischen Küste um Marokko und den Atlantischen inseln bis Kamerun. . .' (239).
'. . . De Norvège aux Canaries. . .' (89).
[As *Corallina (Jania) rubens* Linnaeus]
Cape Verde Islands (38).
'. . . De la Norvège aux Canaries. . .' (38).
[As *Jania rubens* Lamouroux]
Canaries (439; 499; 547).
Cape Verde Islands (445; 446; 499).
'. . . In den wärmeren Teilen aller Ozeane. . .' (499).
'. . . Nordwestafrika' (499).
[As *Jania rubens* (Linnaeus) Lamouroux forma *corniculata*]
Canaries (70).
[As *Jania rubens* (L.)]
Canaries (3).

Overall Note. See also the notes to *Jania verrucosa* Lamouroux.

Jania tenella Kützing
Cape Verde Islands (150; 598; 541).
[As *Corallina (Jania) tenella* Kützing]
Cape Verde Islands (38).

Jania verrucosa Lamouroux
Cape Verde Islands (641).
Côte d'Ivoire (350; 586).
Ghana (350; 376; 377; 586; 590).
Liberia (350; 586).
Mauritanie (624).

Sierra Leone (295; 350; 586).
'Tropical Africa (N. Gambia—Congo river)' (598).
'. . . widespread in warm temperate and tropical seas' (350; 586).
[As *Jania fastigiata* Harvey]
Angola (352).
Côte d'Ivoire (287; 295).
Ghana (295; 590).
Liberia (129; 287; 295).
[As *Jania rubens* (Linnaeus) Lamouroux]
Nigeria (Herb. BM).
São Tomé (535).

Note. The Mauritanie record in Marcot-Coguengniot (624: 198) expressed doubt as to the specific determination. It may well be that material from Nigeria collected by Steentoft and examined by Johansen contains both *J. verrucosa* (as '*fastigiata* prox.') and *J. rubens* (specimen clump in BM). See Steentoft (535: 127–8) and Lawson & John (350: 230) for additional data on the taxa and distinctions between them.

Jania spp.
Angola (352).
Canaries (5; 175; 229; 232B; 301; 302; 303; 393; 394).
Cape Verde Islands (423).
Côte d'Ivoire (287).
Ghana (290; 297; 340; 344; 376; 377; 487; 567).
Liberia (287).
Sénégal (50; 399).
'West Africa' (290; 344).

Kallymenia dentata (Suhr) J. Agardh
See *Anatheca montagnei* Schmitz.

Kallymenia feldmannii Codomier
Canaries (635).

Kallymenia microphylla J.Agardh
Canaries (191; 273; 392; 584).
[As *Callymenia microphylla* J. Agardh]
Canaries (70; 177).
[As *Callymenia (Meredithia) microphylla* J. Agardh]
Canaries (493).

Note. Both Sauvageau (493: 184) and Børgesen (70) expressed doubt on the exact nature of their material due to its juvenile state, poor development, scarcity or sterility. If correctly determined, all records should appear under *Meredithia microphylla* (J. Agardh) J. Agardh.

Kallymenia perforata J. Agardh
Canaries (598).

Note. According to Schneider & Searles (642: 285–6), the material from North Carolina named thus has subsequently proved to relate to *K. westii* Ganesan, described from Venezuela. Ganesan (1976) suggested, when describing the latter, that all Caribbean vegetative material might really be *K. westii*, *K. perforata* being restricted to the Indian and Pacific Oceans. This possibility applies to eastern as well as to western Atlantic material—Prud'homme van Reine (pers. comm.), whose records in 598 are the basis for this entry, certainly considers so.

Kallymenia reniformis (Turner) J. Agardh
Canaries (191; 227; 273; 547; 598).
Cape Verde Islands (598)
[As *Callymenia reniformis* Agardh]
Canaries (70; 191; 547).

Note. Børgesen (77: 230) confirmed the determination of Vickers's specimens. Much of the material detected (70; 77) has been small and sterile.

[As *Callymenia reniformis* (Turner) J. Agardh]
Canaries (77; 499).
'. . . in oceano Atlantico caldiore. . .' (131).
'Nordwestafrika' (499).

Kallymenia requienii J. Agardh
Canaries (635).

Kallymenia schizophylla J. Agardh
Cape Verde Islands (36B; 191; 598).
Namibia (36B; 348).
[As *Callymenia schizophylla* (Harvey) J. Agardh]
Cape Verde Islands (38; 117; 118; 119; 123).
Sénégal (123).
'. . . communes aux îles du Cap Vert et à l'Afrique meridionale. . .' (38)
[As *Kallymenia schizophylla* Harvey]
Cape Verde Islands (145).

Kallymenia westii Ganesan
See the note to *Kallymenia perforata* J. Agardh.

Kallymenia spp.
Namibia (348).
[As *Callymenia* sp.]
Sénégal (529).

ACKNOWLEDGEMENTS. We acknowledge with thanks assistance from many sources, of which the principal are: (i) The Natural History Museum, Department of Botany, London, for provision of the necessary research facilities to continue the series of papers of which the present is part; (ii) Dr W. J. Woelkerling for helping us with critical aspects of genera of crustose algae (especially **Hydrolithon**); (iii) the editorial expertise of Dr. R. Huxley for detecting inaccuracies in the submitted text; (iv) a grant (for GWL) towards this work from the Systematics Association; (v) Dr W.F. Prud'homme van Reine for additional unpublished data in the form of records and comments, as well as for partial revision of the manuscript.

References in Numerical Order

1 Abbott, 1984a.
2 Acuña Gonzáles, 1970.
4 Acuña Gonzáles, 1972
5 Acuña Gonzáles *et al.*, 1970.
6 Adey & Lebednik, 1967.
8 Afonso-Carrillo, 1980a.
9 Afonso-Carrillo, 1980b.
13 Afonso-Carrillo & Gil-Rodriguez, 1980.
16 Afonso-Carrillo & Wildpret, 1978.
18 Haroun Tabraue et al., 1984.
24 Agardh, 1851.
25 Agardh, 1852.
26 Agardh, 1863.
27 Agardh, 1867.
30 Aleem, 1978.
33 Ardré, 1970.
36 Wynne, 1985.
36A Wynne, 1985.
36B Wynne, 1986.
37 Askenasy, 1888.
38 Askenasy, 1897.
38B Audiffred & Weisscher, 1984.
38C Audiffred, 1985.
38D Audiffred & Prud'homme van Reine, 1985.
39 Baardseth, 1941.

41 Barton, 1897.
42 Barton, 1901.
44 Benitez, 1928.
47 Bodard, 1965.
49 Bodard, 1966a.
50 Bodard, 1966b.
52 Bodard, 1967.
53 Bodard, 1968.
55 Bodard, 1971a.
56 Bodard, 1971b.
57 Bodard, 1971c.
58 Bodard, 1971d.
59 Bodard & Mollion, 1974.
60 Børgesen, 1916.
61 Børgesen, 1917.
64 Børgesen, 1920.
70 Børgesen, 1929.
71 Børgesen, 1930.
77 Børgesen, 1938.
78 Børgesen, 1939.
89 Bornet, 1892.
92 Buchanan, 1958.
93 Carpine, 1959.
97 Chapman, 1963.
99 Chevalier, 1920.
100 Chevalier, 1935.
102 Chiang,1970.
108 Cordeiro-Marino,1978.
117 Dangeard, 1948.
118 Dangeard, 1949a.
119 Dangeard, 1949b.
122 Dangeard, 1952.
123 Dangeard, 1958.
128 Delf & Michell, 1921.
128A Delgado et al., 1986.
129 De May et al., 1977.
131 De Toni, 1897.
132 De Toni, 1900.
133 De Toni, 1903.
134 De Toni, 1905.
135 De Toni, 1908
136 De Toni, 1909a
137 De Toni, 1909b.
139 De Toni, 1924.
140 De Toni & Forti, 1913.
145 Dickie, 1874c.
150 Dickie, 1877.
163 Dinter, 1922a.
164 Dinter, 1922b.
165 Dinter, 1924.
172 Dixon & Irvine, 1977.
174 Dor, 1961.
175 Duffus & Johnston, 1969.
177 Edelstein, 1964.
179 Falkenberg, 1901.
182 Feldmann & Bodard, 1965.
183 Feldmann, 1935.
184 Feldmann, 1937.
186 Feldmann, 1938.
188 Feldmann, 1939.
189 Feldmann, 1941.
190 Feldmann, 1942.
191 Feldmann, 1946.
206 Foslie, 1907.
213 Fox, 1957.
215 Gain, 1914.
221 Gayral, 1958.
222 Gayral, 1966.
225 Gil-Rodríguez, 1980.
226 Gil-Rodríguez & Afonso-Carrillo, 1980.
227 Gil-Rodríguez, 1981.
228 Gil-Rodríguez, 1982.
229 Gil-Rodríguez & Wildpret de la Torre, 1980a.
230 Gil-Rodríguez & Wildpret de la Torre, 1980b.
231 Gil-Rodríguez et al., 1978.
232B Gil-Rodríguez et al., 1985.
233 Gomez Garreta et al., 1979.
235 Gonzalez Henriquez, 1976.
236 Gonzales, 1977a.
237 Gonzales, 1977b.
238 Gonzales, 1980.
239 Goor, 1923.
241 Granger, 1964.
249 Hariot, 1895.
250 Hariot, 1896.
251 Hariot, 1908.
252 Hariot, 1911.
253 Haroun Tabraue et al., 1984.
254 Harvey, 1846-1851.
256 Harvey, 1862.
257 Harvey, 1863.
258 Harvey [& Hooker], 1855.
259 Hemsley, 1885a.
260 Hemsley, 1885b.
261 Henriques, 1885.
262 Henriques et al., 1886.
263 Henriques, 1886.
264 Henriques, 1887
265 Henriques, 1917.
266 Heydrich, 1894.
267A Hoek, 1982.
269 Hoppe, 1969.
273 Irvine, 1983.
282 Jardin, 1851.
283 Jardin, 1875.
287 John, 1972.
288 John, 1977.
290 John, 1986.
291 John & Asare, 1975.
292 John & Lawson, 1972a.
293 John & Lawson, 1972b.
294 John & Lawson, 1974.
295 John & Lawson, 1977a.
296 John & Lawson, 1977b.
297 John & Pople, 1973.
298 John et al., 1981.
299 John et al., 1977.
300 John et al., 1980.
301 J[ohnston], 1966.
302 Johnston, 1969a.
303 Johnston, 1969b.
304 Johnston, 1969c.
306B Jorge et al., 1986.
312A Kensley & Penrith, 1980.
318 Kützing, 1849.
322 Kützing, 1864.
323 Kützing, 1865.
335 Lawson, 1953.

336 Lawson, 1954.
337 Lawson, 1955.
338 Lawson, 1956.
339 Lawson, 1957a.
340 Lawson, 1957b.
342 Lawson, 1960.
344 Lawson, 1966.
346 Lawson, 1980.
348 Lawson et al. 1990.
349 Lawson & John, 1977.
350 Lawson & John, 1982.
351 Lawson & Norton, 1971.
352 Lawson et al., 1975.
356 Lemoine, 1915.
357 Lemoine, 1917a.
358 Lemoine, 1917b.
359 Lemoine, 1924.
363 Lemoine, 1929.
374 Levring, 1969.
375 Levring, 1974.
376 Lieberman *et al.*, 1979.
377 Lieberman et al., 1984.
378 Longhurst, 1958.
379 Lopez Hernandez & Gil-Rodríguez, 1982.
385 Martens, 1866.
386 Martin Aguado, 1957.
390 Mazza, 1905–1925.
392 Meñez & Mathieson, 1981.
393 Michanek, 1971.
394 Michanek, 1975.
396 Michanek, 1983
398 Mollion, 1973.
399 Mollion, 1976.
401 Montagne, 1839–1841.
402 Montagne, 1842.
403 Montagne, 1846a.
404 Montagne, 1846b.
407 Montagne, 1856.
408 Montagne, 1860.
409 Mshigeni, 1977.
410 Murray, 1888–1889.
411 Naegelé, 1960.
414 Niell, 1974.
423 Palminha, 1960.
424 Palminha, 1961.
428 Palminha et al., 1963.
437 Penrith & Kensley, 1970a.
438 Penrith & Kensley, 1970a.
439 Piccone, 1884.
440 Piccone, 1885.
442 Piccone, 1886a.
443 Piccone, 1886b.
445 Piccone, 1887a.
446 Piccone, 1887b.
449 Piccone, 1890.
450 Piccone, 1900.
451 Piccone, 1901.
454 Pilger, 1911.
456 Pilger, 1920.
457 Pilger, 1922.
474 Price & John, 1978.
475 Price & John, 1980.
480 Rama Rao, 1977.
481 Rama Rao, 1982.
482 Reinbold, 1907.
483 Reinbold, 1908.
484 Richardson, 1969.
485 Rodrigues, 1960.
487 Round, 1981.
489 Santos Guerra, 1972.
490 Santos Guerra, et al., 1970.
491 Sanusi, 1980.
493 Sauvageau, 1912.
495 Schiffner, 1931.
496 Schmidt, 1924.
497 Schmidt, 1929a.
498 Schmidt, 1929b.
499 Schmidt, 1931.
500 Schmidt & Gerloff, 1957.
501 Schmitz & Falkenberg, 1897.
506 Schmitz & Hauptfleisch, 1896–97a.
507 Schmitz & Hauptfleisch, 1897b.
510 Schmitz & Hauptfleisch, 1897c.
515 Searles, 1968.
516 Seone-Camba, 1960.
517 Seone-Camba, 1965.
523 Simons, 1974.
528 Sonder, 1852.
529 Sourie, 1954a.
531 Sourie, 1954b.
535 Steentoft, 1967.
537 Stephenson & Stephenson, 1972.
541 Tittley et al., 1984.
542 Trochain, 1940.
544 Tseng et al., 1982.
546 Varo et al., 1979.
547 Vickers, 1897.
548 Viera y Clavijo, 1866.
553 Weber-van Bosse, 1921.
555 Weisscher, 1982.
556 Weisscher, 1983.
561A Wynne & Kraft, 1985.
565A Yarish et al., 1984.
567 Lüning, 1985.
582 Afonso-Carrillo et al., 1985.
583 Haroun Tabraue et al., 1985.
584 Ribero Siguan et al., 1985.
586 Lawson & John, 1987.
590 John & Lawson (unpublished).
594 Lawson, 1954.
595 Hannach & Waaland, 1986.
598 Prud'homme van Reine, W.F.; pers. comm., 10/4/87.
602 Villena-Balsa et al., 1987.
602A Gil-Rodríguez et al., 1987.
604 Viera-Rodríguez, 1987.
605 Viera-Rodríguez et al., 1987.
610 Gonzalez, 1979.
616 Suhr, 1831.
618 Rengasamy & Ilanchelian, 1988.
619 Perez-Cirera, 1975a.
620 Perez-Cirera 1975b.
621 Sanson Acedo, 1991.
622 Perez-Cirera, 1973.
623 Mollion, 1978.
624 Marcot-Coqueugniot, 1991.
625 Prud'homme van Reine & Hoek, 1988.
626 Schenkman, 1989.
627 Ardré, 1959.

628 Breeman & Ten Hoopen, 1981.
635 Heincke Expedition, 1991: pers. comm., W.F. Prud'homme van Reine, R.J. Haroun & E. Serrao.
636 Ballesteros, E., leg. et det.; latter confirmed W.F. Prud'homme van Reine, pers. comm.
637 Otero-Schmitt, J., leg. et det.; latter confirmed W.F. Prud'homme van Reine, pers. comm..
638 Viera-Rodriguez, M.A., leg. et det.; W.F. Prud'homme van Reine, pers. comm.
639 Prud'homme van Reine, W.F. & Pakker, H., pers. comm., 1991.
640 Haroun, R.J. & Prud'homme van Reine, W.F., pers. comm., 1991.
641 Otero-Schmitt, J., leg. et det.; W.F. Prud'homme van Reine, pers. comm.
642 Schneider, C.W. & Searles, R.B., 1991.
643 Prud'homme van Reine, W.F.; pers. comm., 19/11/91, of reallocations following examination of original Piccone material from the Canaries.
644 Lawson et al., 1992.

REFERENCES

Abbott, I.A. 1984. Two new species of *Liagora* (Nemaliales,Rhodophyta) and notes on *Liagora farinosa* Lamouroux. *Am. J. Bot.* **71**: 1015–1022.

——, **Zhang, Junfu & Xia, Bangmei** 1991. *Gracilaria mixta*, sp. nov. and other western Pacific species of the genus (Rhodophyta: Gracilariaceae). *Pacific Sci.* **45**: 12–27.

Acuña Gonzáles, A. 1970. Algunos aspectos de la vegetación submarina de las Islas Canarias. *Vieraea* [**1**]: 2–5.

—— 1972 ['1968–70']. Cinco nuevas citas de algae Rhodophyceae en la Isla de Tenerife. *Anales Univ. La Laguna* **7**: 3–6.

Acuña G[onzáles,], A. Santos G[uerra], A. & Wildpret [de la Torre], W. 1970. Algunos aspectos de la vegetación algal de la Playa de San Marcos, Icod, Tenerife. *Cuad. Bot. canaria* **9**: 30–36.

Adey, W.H. & Lebednik, P.A. 1967. *Catalog of the Foslie Herbarium.* Trondheim, Norway: Det Kongelige Norske Videnskabers Selskab Museet. pp. [1]+92.

——, **Townsend, R.A. & Boykins, W.T.** 1982. The crustose coralline algae (Rhodophyta: Corallinaceae) of the Hawaian Islands. *Smiths. Contrib. mar. Sci.* **15**: i–iv+1–74.

Afonso-Carrillo, J. 1980a. Algunas observaciones sobre la distri bución vertical de las algas en la Isla del Hierro (Canarias). *Vieraea* **10**(1–2): 3–16.

—— 1980b. Nota sobra algunas Corallinaceae (Rhodophyta) nuevas para la flora ficologica de las Islas Canarias. *Vieraea* **10**(1–2): 53–58.

—— 1985. Conexiones intercelulares entre diferentes talos de *Neogoniolithon absimile* (Foslie et Howe) Cabioch (Corallinaceae, Rhodophyta). *Vieraea* **15**: 139–142.

—— **& Gil-Rodríguez, M.C.** 1980. Datos para la flora marina de la Isla de Fuerteventura. *Vieraea* **10**(1–2):147–170.

—— **& Gil-Rodríguez, M.C.** 1981. Sobre el limite meridional de *Sauvageaugloia chordariaeformis* (Crouan) Kylin (Chordariaceae, Phaeophyta). *Investigación pesq.* **45**: 297–300.

——, **Gil-Rodríguez, M.C. & Wildpret de la Torre, W.** 1979 ['1978']. Estudio de la vegetación algal de la costa del futuro poligono industrial de Granadilla (Tenerife). *Vieraea* **8**: 201–242.

——, **Gil-Rodríguez, M. C. & Wildpret de la Torre, W.** 1985 ['1984']. Algunas consideraciones florísticas, corológicas y ecológicas sobre las algas Corallinaceae (Rhodophyta) de las Islas Canarias. *An. Biol. Fac. Biol. Univ. Murcia* **2** (Secc. Esp. 2): 23–37.

——, **Gil-Rodríguez, M. C., Haroun Tabraue, R., Villena Balsa, M. & Wildpret de la Torre, W.** 1984 ['1983']. Adiciones y correcciones al catalogo de algas marinas bentonicas para el Archipielago Canario. *Vieraea* **13**: 27–49.

Agardh, J.G. 1851. *Species genera et ordines algarum, . . . floridearum. . .* **2**(1). Lund.
Note. Facsimile reprint, J. Cramer, 1977.

—— 1852. *Species genera et ordines algarum, . . . floridearum, . . .* **2**(2). Lundae.
Notes. 1. The Corallineae (Ordo XII. pp. 506–576) was by J.E. Areschoug—so stated in volume. 2. Some versions of this second volume, Pars II, were issued as two separate texts—Pars II:1 being dated 1851 and Pars II:2 1852. 3. There are also internal differences of numbering of pages between copies. BM copy is numbered straight through from 337–720, including therein the Addenda [701–706] and Index [707–720]. In the copy from which the Cramer (1977) reprint was prepared, the Index [unnumbered, of 14 sides] is placed immediately after p. 700 and is followed by six sides [also unnumbered] of Addenda. Content of these unnumbered sides is exactly as the numbered BM pages. The BM copy of Vol. 2 Part 3 (1863) commences with pages headed 'Ordo XIV. Wrangelieae', and numbered 701–715; these are followed by 'Ordo XV. Chondrieae' [pp. 716–786]. All these latter pages [701–786], also so numbered, are in the Cramer (1977) version placed immediately after the unnumbered Addenda pages (see above) and before the title page to Vol. 2, Part 3, of 1863, thereby implying that the copy facsimiled was also so arranged. Pages from 787 to 1291 are in both cases in Vol. 2, Part 3, 1863. Despite this, the Index in the end of the Cramer (1977) facsimile of Vol. 2, Part 3 (pp. 1279–1291) indicates the same page numbers as does the BM version. Both dated texts are indicated as the sources of data where the records occur in pp. 701–786 [textual pages]. The implication behind all this is that there may be yet other differently paged versions elsewhere.

—— 1863. *Species genera et ordines algarum....floridearum . . .* **2**(3). Lundae.

—— 1876. *Species genera et ordines algarum . . .* 3: *De Florideis curae posteriores*. Part 1. *Epicrisis systematis floridearum*. Lipsiae.

Aleem, A.A. 1978. A preliminary list of marine algae fromSierra Leone. *Botanica mar.* **21**: 397–399.

Apt, K.E. 1987. A new species of *Janczewskia* (Rhodomelaceae, Rhodophyta) from the Hawaiian Islands. *Phycologia* **26**: 328– 333.

Ardré, F. 1959. Un intéressant *Hildenbrandtia* du Portugal. *Revue algol.* sér., **4**: 227–237.

—— 1970 ['1969–70']. Contribution à l'étude des algues marines du Portugal I—La Flore. *Port. Acta biol.* B, **10** 137–555+[56].
Note. The reprint is paged 1–423+[56].

Askenasy, E. 1888 ['1889']. Algen, mit Unterstützung der Herren E. Bornet, A. Grunow, P. Hariot, M. Moebius, O. Nordstedt bearbeitet. *In* A. Engler, *Die Forschungsreise S.M.S. 'Gazelle' in den Jahren 1874 bis 1876 unter Kommando des Kapitän zur See Freiherrn von Schleinitz herausgegeben von dem Hydrographischen Amt des Reichs-Marine-Amts*. IV. Theil. *Botanik*. 1–58. Berlin.
Note. Publication of the algal section was definitely originally in 1888, since it was noted in *Nat. Novid., Berlin*, No. 21, October 1888, p. 328. The overall title page for Theil IV was issued 1889 and since the whole Theil seems also to have been issued in soft covers (also dated 1889), the algal portion was probably reissued on that date.

—— 1897. Enumération des algues des îles du Cap Vert. *Bolm Soc. broteriana* **13**: 150–175.
Note. For date of publication, see Silva (1960). Reprints of this work are believed to be repaged 1–25.

Audiffred, P.A.J. & Weisscher, F.L.M. 1984. Marine algae of Selvagem Grande (Salvage Islands, Macaronesia). *Bolm Mus. munic. Funchal* **36**: 5–37.

—— 1985 ['1984']. Marine algae of El Hierro (Canary Islands). *Vieraea* **14**: 157–183.

—— **& Prud'homme van Reine, W.F.** 1985. Marine algae of Ilha do Porto Santo and Deserta Grande (Madeira Archipelago). *Bolm Mus. munic. Funchal* **37**: 20–51.

Baardseth, E. 1941. *The marine algae of Tristan da Cunha*.Results of the Norwegian Scientific Expedition to Tristan da Cunha 1937–1938. No. 9. Oslo.

Ballesteros, E., Collections from subtidal of Canary Islands, det. by collector and confirmed by W.F. Prud'homme van Reine; Prud'homme van Reine, pers. comm. to D.M. John, 19/11/91.

Barton, E.S. 1897. Welwitsch's African marine algae. *J. Bot., Lond.* **35**: 369–374.

—— 1901. Marine algae [pp. 324–328]. *In* Anon.[W.P. Hiern?], *Catalogue of the African plants collected by Dr Friedrich Welwitch in 1853–61*. **2**(2) *Cryptogamia*. London.

Benítez, A.J. 1928(?). *Historia de las Islas Canarias (Edición ilustrada)*, [vol. I]. Santa Cruz de Tenerife.
Note. The work does not appear to be dated but the BM copy was received 3 July 1928 and 1928 has been impressed on the spine. The flora, entitled 'Fitografia Canaria . . .' and appearing on pp. 137–144, appears simply to be a list of plant names taken from Montagne (401) in Barker-Webb & Berthelot (*q.v.*). The reference to 'vol. I' indicates simply that only the first 528 of a total of more than 1000 pages were published.

Bodard, M. 1965. *Grateloupia senegalensis*, nouvelle espèce de l'Ouest africain [Rhodophyta, Cryptonémiales]. *Bull. Inst. fr. Afr. noire* sér. A, **27**: 1211–1220.

—— 1966a. Sur le développement des tetrasporocystes d'*Anatheca montagnei* Schmitz [Solieriacées, Gigartinales]. *Bull. Inst. fond. Afr. noire* sér. A,**28**: 867–894.

—— 1966b. Première liste des espèces d'algues présentes sur la Pointe de Sarène (Sénégal). *Notes afr.* **111**: 81–89.
—— 1967. Les *Gracilaria* et *Gracilariopsis* au Sénégal. *Ann. Fac. Sci. Dakar* **19**: 27–55, 1966.
—— 1968. Les *Hypnea* au Sénégal [Hypnéacées, Gigartinales]. *Bull. Inst. fond. Afr. noire* sér. A,**30**: 811–829.
—— 1971a. *Halymenia senegalensis*, nov. sp. [Algae], espèce caractéristique de l'infralittoral Sénégalais. *Bull. Inst. fond. Afr. noire* sér. A,**33**: 1–19.
—— 1971b. Sur un genre nouveau de Delesseriacées: *Pseudobranchioglossum senegalense*, algue de l'infralittoral sénégalais. *Bull. Inst. fond. Afr. noire* sér. A,**33**: 20–31.
—— 1971c. Étude morphologique et cytologique d'*Helminthocladia senegalensis* (Rhodophycées), Nemalionale nouvelle à carpotétraspores et à cycle haplodiplophasique. *Phycologia* **10**: 361–374.
—— 1971d. Le cycle du Rhodophycees: recherches actuelles sur les Nemaliales. *Bull. Soc. Bot. nord France* **24**: 111–119.
—— **& Mollion, J.** 1974. La végétation infralittorale de la petite côte sénégalaise. *Bull. Soc. phycol. Fr.* **19**: 193–221.
Boillot, A. 1965. Sur l'alternance de générations hétéromorphes d'une Rhodophycée, *Halarachnion ligulatum* (Woodward) Kützing (Gigartinales, Furcellariacées). *C. r. hebd. Séanc. Acad. Sci., Paris* **261**: 4191–3.
—— 1972. Le cycle de l'*Halarachnion ligulatum* (Woodward) Kuetzing (Rhodophycée, Gigartinales). *Mém. Soc. bot. Fr.* **1972**: 275–291.
Børgesen, F. 1916. The marine algae of the Danish West Indies Vol. 2 Rhodophyceae [pt.2]. *Dansk bot. Ark.*3(1b): **81**–144.
—— 1917. The marine algae of the Danish West Indies Vol. 2 Rhodophyceae [pt.3]. *Dansk bot. Ark.* **3**(1c): 145–240.
—— 1920. The marine algae of the Danish West Indies Vol. 2. Rhodophyceae [pt. 6]. With Addenda to the Chlorophyceae, Phaeophyceae and Rhodophyceae. *Dansk bot. Ark.* **3**(1f): 369–504.
—— 1929. Marine algae from the Canary Islands especially from Teneriffe and Gran Canaria III. Rhodophyceae Part II Cryptonemiales, Gigartinales and Rhodymeniales. Les Mélobésiées by (par) Mme Paul Lemoine. [*K. danske Vidensk. Selsk.] Biol. Meddr.* **8**(1): 1–97+[9].
—— 1930. Marine algae from the Canary Islands especially from Teneriffe and Gran Canaria III. Rhodophyceae Part III Ceramiales. [*K. danske Vidensk. Selsk.] Biol. Meddr.* **9**(1):1–159.
—— 1938. Sur une collection d'algues marines recueillies à une profondeur remarquable près des Iles Canaries. *Revue algol.* **11**: 225–230.
—— 1939. Marine algae from the Iranian Gulf especially from the innermost part near Bushire and the Island Kharg. *Dan. scient. Invest. Iran* **1**: 1–141.
Bornet, É. 1892. Les algues de P.-K.-A. Schousboe, récoltées au Maroc dans la Méditerrannée de 1815 à 1829, et determinées par M. Edouard Bornet. *Mém. Soc. natn. Sci. nat. Math. Cherbourg* **28**: 165–376.
Note. Also published as a separate, with new prefatory pages, dated 1892, and bearing two sets of pagination—the original as in the journal and a repagination from p. 1 to 216. Because of the prefatory pages, the original p. 165 becomes p. 5. Published Paris: Librairie G. Masson.
Breeman, A.M. & Ten Hoopen, A. 1981. Ecology and distribution of the subtidal red alga *Acrosymphyton purpuriferum* (J. Ag.) Sjöst. (Rhodophyceae, Cryptonemiales). *Aquatic Bot.* **11**: 143–166.
Buchanan, J.B. 1958. The bottom fauna communities across the continental shelf off Accra, Ghana (Gold Coast). *Proc. zool. Soc. Lond.* **130**: 1–56.
Cabioch, J. 1972. Étude sur les Corallinacées. II. La morphogènese, conséquences systématiques et phylogénétiques. *Cah. Biol. mar.* **13**: 137–288.
Carpine, C. 1959. Aperçu sur les peuplements littoraux [pp. 75–90]. *In* J. Forest, Campagne de la Calypso dans le golfe de Guinée et aux îles Príncipe, Sao Tomé, Annobon (1956). *Annls Inst. océanogr., Monaco* **37**: 1–244.
Chapman, V.J. 1963. The marine algae of Jamaica Part 2. Phaeophyceae and Rhodophyceae. *Bull. Inst. Jamaica, Sci. Ser.* **12**(2): 1–195.
Chevalier, A. 1920. *Exploration botanique de l'Afrique occidentale Française* Tome 1. *Enumération des plantes récoltées avec une carte botanique, agricole et forestière*. pp.xiii+[3]+798. Paris.
Note. The algae (pp. 785–788) are acknowledged as being determined by P. Hariot.
—— 1935. Les Iles du Cap Vert. Géographie, biogéographie, agriculture Flore de l'Archipel. *Revue Bot. appl. Agric. trop.*. **15**: 733–1090.
Note. A separate exists, bearing old pagination at top, but repaged at bottom [2]+1–358+[1]. See also no. 183.
Chiang, Y.-M. 1970. Morphological studies of red algae of the family Cryptonemiaceae. *Univ. Calif. Publs Bot.* **58**: vi+1–95.
Codomier, L. 1973. Caractères généraux et développment des spores de *Sebdenia dichotoma* (J. Ag.) Berthold (Rhodophycées, Gigartinales). *Phycologia* **12**: 97–105.
—— 1974. Recherches sur la structure et le développement des *Halymenia* C. Ag. (Rhodophycées, Cryptonemiales) des côtes de France et de la Méditerranée. *Vie Milieu* sér. A, *Biol. Mar.*, **24**:1–24.
Cordeiro-Marino, M. 1978 ['1977']. Rodofíceas bentônicas marinhas do Estado de Santa Catarina. *Rickia* **7**: [6]+1–243.
Cremades, J. & Perez-Cirera, J.L. 1990. Nuevas combinaciones dealgas bentónicas marinas, como resultado del estudio del herbario de Sunón de Rojas Clemente y Rubio (1777–1827). *An. Jard. bot. Madrid* **47**: 489–492.
Dangeard, P. 1948. Sur la flore des algues marines du Maroc Occidental. *C. r. hebd. Séanc. Acad. Sci., Paris* **227**: 364–365.
—— 1949a. Les algues marines de la côte occidentale du Maroc. *Botaniste* **34**: 89–189.
—— 1949b. Les algues marines de la côte occidentale du Maroc. *P.-v. Soc. linn. Bordeaux* **94**(2): 73–74.
—— 1952. Algues de la presqu'ile du Cap Vert (Dakar) et de ses environs. *Botaniste* **36**: 193–329.
—— 1958. Notice sur les travaux scientifiques(1931–1956) de M. Pierre Dangeard, . . . *Botaniste* **42**, Supplément: [2]+1–98+[4].
Delf, E.M. & Michell, M.R. 1921. The Tyson Collection of marine algae. *Ann. Bolus Herb.* **3**: 89–119.
Delgado, E., Gonzales, M.N. & Jorge, D. 1986 ['1984'].Contribución al estudio de la vegetación ficológica de la zona de Arinaga (Gran Canaria). *Bot. Macaron.* **12–13**: 97–110.
De May, D., John, D.M. & Lawson, G.W. 1977. A contribution to the littoral ecology of Liberia. *Botanica mar.* **20**: 41–46.
De Toni, G.B. 1897. *Sylloge algarum omnium hucusquecognitarum. . .* **4** *Sylloge Floridearum* . . . Sectio I.— Familiae I–XI. pp. XX+LXI+[3]+386+[2]. Patavii.
—— 1900. *Sylloge algarum omnium hucusque cognitarum. . .* **4** *Sylloge Floridearum* . . . Sectio II—Familiae I–IV. pp. [6]+387–776. Patavii.
—— 1903. *Sylloge algarum omnium hucusque cognitarum. . .* **4** *Sylloge Floridearum* . . . Sectio III— Familiae V–VI. pp. [6]+775–1525. Patavii.
—— 1905. *Sylloge algarum omnium hucusque cognitarum. . .* **4** *Sylloge Floridearum* . . . Sectio IV—Familiae I–VII. pp. [6]+1523–1873. Patavii.
—— 1908. Litteratura phycologica florae et miscellanea phycologia. *Nuova Notarisia* **19** [=**23** from beginning]:25–46.
—— 1909a. Litteratura phycologica florae et miscellanea phycologica. *Nuova Notarisia* **20**: 42–64.
—— 1909b. Hariot, P.—Les Algues de San Thomé (côte occidentale d'Afrique.—Journal de Botanique XXI, 1908, n. 7, pag. 161–164, 1 fig.). *Nuova Notarisia* **20** [=**24** from *Notarisia* start]: 59.
—— 1924. *Sylloge algarum omnium hucusque cognitarum. . .* **6.** *Sylloge Floridearum* . . . Sectio V. *Additamenta*. pp. XI+[1]+719. Patavii.
—— **& Forti, A.** 1913. Contribution à la flore algologique de la Tripolitaine et de la Cyrénaïque. *Annls Inst. océanogr., Monaco* **5**(7): 1–56.
Dickie, G. 1874. Enumeration of algae collected at the Cape-Verde Islands by H.N. Moseley, M.A., naturalist to H.M.S. 'Challenger'. *J. Linn. Soc.* (Bot.) **14**: 344–349.
—— 1877. Supplemental notes on algae collected by H.N. Moseley, M.A., of H.M.S. 'Challenger' from various localities. *J. Linn. Soc.* (Bot.) **15**: 486–489.
Dinter, K. 1922a. Index, der aus Deutsch-Südwestafrika bis zum Jahre 1917 bekannt gewordenen Pflanzenarten. XI. *Reprium nov. Spec. Regni veg.* **18**: 248–256.
—— 1922b. Index, der aus Deutsch-Südwestafrika bis zum Jahre 1917 bekannt gewordenen Pflanzenarten. XII. *Reprium nov. Spec. Regni veg.* **18**: 423–444.
—— 1924. Index, der aus Deutsch-Südwestafrika bis zum Jahre 1917 bekannt gewordenen Pflanzenarten. XVI. *Reprium nov. Spec. Regni veg.* **19**: 315–320.
Dixon, P.S. & Irvine, L.M. 1977. *Seaweeds of the British Isles* Volume 1 *Rhodophyta* Part 1 *Introduction, Nemaliales, Gigartinales*. pp. xi+[1]+252. London.
Dor, I. 1961. Quelques Rhodophycées dorsiventrales et bilaterales des côtes Israeliennes. *Bull. Res. Coun. Israel* sect. D, **10**: 37–53.
Duffus, J. & Johnston, C.S. 1969. Marine Mollusca from the Canary Island of Lanzarote. *J. Conch. Lond.* **27**: 27–45.
Edelstein, T. 1964. On the sublittoral algae of the Haifa Bay area. *Vie Milieu* **15**: 177–212.
Falkenberg, P. 1901. Die Rhodomelaceen des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. *In* Anon., *Fauna und Flora des Golfes von Neapel und der angrenzenden Meeres-Abschnitte*. Herausgegeben von der zoologische Station zu Neapel. **26** Monographie, pp. XVI+754+[48]. Berlin.
Feldmann, G. & Bodard, M. 1965. Une nouvelle espèce de *Botryocladia* des côtes du Sénégal. *Bull. Inst. océanogr. Monaco* **65**(1342): 1–14.
Feldmann, J. 1935. Algues marines des Iles du Cap Vertrecoltées par M. le Professeur Aug. Chevalier [pp. 1069–1071]. *In* A. Chevalier, Les Iles du Cap Vert. Géographie, Biogéographie, Agriculture Flore de l'Archipel. *Rev. Bot. appl. Agric. trop.* **15**: 733–1090.
Note. This is also published as a separate with the original page numbers retained at the top of each page and a new sequence (pp. 1–358) at the bottom of the page. See also no. 100.
—— 1937. *Recherches sur la végétation marine de la Méditerranée. La Côte des Albères*. pp. [8]+339+[2].

Note. Originally published as *Revue algol*. 10:1–339. Printed 28 October 1937, but published with '1938' on title-page of part. The separate form was published with '1937' on title-page andattributed inside as extracted from the *Revue Algol*. Tome X, Nov. 1937. The BM copy of the journal was received 22 June 1938. No textual differences exist between the two versions.

—— 1938. Sur la répartition du *Diplanthera wrightii* Aschers. sur la côte occidentale d'Afrique. *Bull. Soc. Hist. nat. Afr. N.* **29**: 107–112.

—— 1939. Les Algues marines de la Côte des Albères. IV—Rhodophycées. *Revue algol*. **11**: 247–330.

Note. Includes Bangiales, Nemalionales, Gelidiales and Cryptonemiales.

—— 1941. Les Algues marines de la Côte des Albères. IV—Rhodophycées (suite). *Revue algol*. **12**: 77–100.

Note. Covers the Gigartinales and Rhodymeniales.

—— 1942. Les Algues marines de la Côte des Albères. IV. Rhodophycées (fin). *Trav. algol*. **1**: 29–113.

Note. Covers Ceramiales. *Travaux algologiques* **1** replaced volume **13** of the original series of*Revue algologique*.

—— 1946. La flore marine des Iles Atlantides. *Mém. Soc. Biogéogr*. **8**: 395–435.

Foslie, M. 1907. Algologiske Notiser III. *K. norske Vidensk. Selsk. Skr.* **1906**(8): 1–34, 1907.

Fox, M. 1957. A first list of marine algae fromNigeria. *J. Linn. Soc.* (Bot.) **55**: 615–631.

Gain, L. 1914. Algues provenant des campagnes de l'*Hirondelle* **II** (1911–1912). *Bull. Inst. océanogr., Monaco* **279**: 1–23.

Ganesan, E.K. 1976. On *Kallymenia westii* sp. nov. (Rhodophyta, Cryptonemiales) from the Caribbean Sea. *Boln Inst. Oceanogr. (Cumaná)* **15**: 169–175.

Garbary, D.J. & Johansen, H.W. 1982. Scanning electron microscopy of *Corallina* and *Haliptilon* (Corallinaceae, Rhodophyta): surface features and their taxonomic implications. *J. Phycol*. **18**: 211–219.

Gayral, P. 1958. *La nature au Maroc II Algues de la côte atlantique marocaine*. pp.[4]+524+errata graviora/addendum slip. Rabat.

—— 1966. *Les algues des côtes Françaises (Manche et Atlantique) Notions fondamentales sur l'écologie, la biologie et la systematiques des algues marines*. pp. 632+[1]. Paris.

Gil-Rodríguez, M.C. 1980 ['1979']. Revision taxonomica-ecologia del genero *Cystoseira* C.Ag. en el archipielago Canario. *Vieraea* **9**(1–2): 115–148.

—— **& Afonso-Carrillo, J.** 1980. Adiciones a la flora marina y catalogo ficologico para la Isla de Lanzarote. *Vieraea* **10**(1–2): 59–70.

—— **& Afonso-Carrillo, J.** 1981 ['1980']. *Catalogo de las algas marinas bentonicas (Cyanophyta, Chlorophyta, Phaeophyta y Rhodophyta) para el Archipielago Canario*. pp. 47[18]. Tenerife.

—— **& Afonso-Carrillo, J. 1982. Sobre la distibución de la familia Dasycladaceae (Chlorophyta) en las Islas Canarias.** *Collnea bot. Barcinone* **13**: 831–839 [*IV Simposio de Botànica Cryptogàmica*, Barcelona 1982: 385–1022].

—— **& Wildpret de la Torre, W. 1980.** *Contribucion al estudio de la vegetacion ficologica marina del litoral Canario*. pp. 100. Tenerife [*Encyclopedia Canaria*].

—— **& Wildpret de la Torre, W. 1980. Contribucion a la ficologia de la Isla del Hierro.** *Vieraea* **8**(2): 245–260.

——**, Acebes Ginoves, J.R. & Perez de Paz, P.L.** 1978. Nueves aportaciones a la flora ficologica de las Islas Salvajes [pp. 45–72]. *In* Anon., *Contribución al estudio de la historia natural de las Islas Salvajes*. Resultados de la Expedición Cientifica 'Agamenon 76' (23 de febrero—3 de marzo de 1976). pp. 209. Santa Cruz de Tenerife, Canarias.

——**, Afonso Carrillo, J. & Wildpret de la Torre, W. 1987. Praderas marinas de** *Zostera noltii* (Zosteraceae) en las Islas Canarias. *Vieraea* **17**: 143–146.

——**, Haroun Tabraue, R. [J.], Afonso-Carrillo, J. & Wildpret de la Torre, W.** 1985. Adiciones al catálogo de algas marinas bentonicas para el Archipielago Canario. II. *Vieraea* **15**(1–2):101–112.

Gomez Garreta, A., Ribera Siguan, A. & Seoane-Camba, J. 1979.Nuevas citas para la flora algológica de Baleares. *Acta bot. Malacitana* **5**: 29–38.

Gonzalez Henriquez, M.N. 1976. Contribución al estudio del epifitismo en *Zostera marina* L. (Zosteraceae) en laplaya dc Las Canteras (Gran Canaria). *Bot. Macaron*. **2**: 59–67.

Gonzalez, N. 1977a. Estudio de la vegetación litoral de la zona de Maspalomas. *Bot. Macaron*. **4**: 23–30.

—— 1977b. Estudio de la vegetación bentonica litoral del noroeste de la Isla de Gran Canaria (Bañaderos, San Felipe, Sardina, Las Nieves). *Bot. Macaron*. **4**: 85–104.

—— 1979 ['1978']. Contribución al estudio algológico de la zona de Arinaga (Gran Canaria). *Bot. Macaron*. **5**: 47–60.

—— 1980 ['1978']. Estudio algológico de la Playa del Burrero(Gran Canaria).*Bot.Macaron*.**6**:43–51.

Note. Issue dated on outer cover December 1978. Presented to BM on 28 May 1980. Date of registration at Las Palmas is 1980—' Imp. Galdos Buenos Aires 38 Dep. Legal G.C. 57—1980. LAS PALMAS.'.

Goor, A.C.J. van 1923. Die Holländischen Meeresalgen (Rhodophyceae, Phaeophyceae und Chlorophyceae) insbesondere der Umgebung von Helder, des Wattenmeeres und der Zuidersee. *Verh. K. Akad. Wet. Amst.*, Tweede sectie, **23**(2): I–IX+[1]+1–232.

Granger, R. 1964. Contribuicão para o conhocimento da composição mineral de alga *Hypnea beneguelensis* Palminha. *Not. mimeogr. Centro. Biol. Piscat., Lisboa* **43**: [2]+1–21+[1].

Hariot, P. 1895. Liste des algues recueillies au Congo par M.H. Lecomte. *J. Bot., Paris* **9**: 242–244.

—— 1896. Contribution à la flore algologique du Gabon et du Congo français. *C. r. Ass. fr. Avanc. Sci*. **24**(2): 641–643,1895 [Bordeaux].

—— 1908. Les algues de San Thomé (Côte occidentale d'Afrique). *J. Bot., Paris*, sér. 2, **1**: 161–164.

—— 1911. Algues de Mauritanie recueillies par M. Chudeau. *Bull. Soc. bot. Fr*. **58** [=sér. 4, **11**]: 438–445.

Hannach, G. & Waaland, J.R. 1986. Environment, distribution and production of *Iridaea*. *Aquatic Bot*. **26**: 51–78.

Haroun, R.J. & Prud'homme van Reine, W.F. Collections from Canary Islands and Cape Verde Islands; *pers. comm.* from W.F. Prud'homme van Reine to D.M. John, 19/11/91. Publication in press.

Haroun Tabraue, R.J., Gil-Rodríguez, M.C., Afonso-Carrillo, J. & Wildpret de la Torre, W. 1984 ['1983']. Estudio del fitobenthos del Roque de los Organos (Gomera). Catalogo floristico. *Vieraea* **13**: 259–276.

——**, Gil-Rodríguez, M.C., Afonso-Carrillo, J. & Wildpret de la Torre, W.** 1985? ['1984']. Estudio ecologico y fenologico dc algunas especies del genero *Caulerpa* Lamouroux presentes en el Archipielago Canario. *Actas IV Simposio Iberico de Estudos do Benthos marinho*, **3**: 75–82.

——**, Gil-Rodríguez, M.C., Afonso-Carrillo, J. & Wildpret de la Torre, W.** 1985 ['1984']. Vegetación bentónica del Roque de Los Organos (Gomera). *An. Biol. Univ. Murcia* **2** (Secc. Esp. 2): 107–117.

Harvey, W.H. 1846–1851. *Phycologia britannica*:. . . , vols **II**, **III**, *Rhodospermeae*,. . . vol. IV. *Chlorospermeae*,. . . [Synopsis nos. 280–388]. London.

—— 1862. *Phycologia australica; or, a history of Australian Seaweeds*;. . . , vol. IV. pp. viii+pls [with text] CLXXXI–CCXL. London.

—— 1863. *Phycologia australica; or, a history of Australian Seaweeds* . . . [vol. V] . . . *and a Synopsis of all known Australian algae*. pp. lxxiii+[1]+pls [with text] CCXLI–CCC. London.

—— **[& Hooker, J.D.]** 1855. Nat. Ord. CIII. Algae, *L*. [pp. 211–266]. *In* J.D. Hooker, *The botany of the Antarctic voyage of H.M. discovery ships* Erebus *and* Terror, *in the years 1839–1843* . . . , Part II. *Flora Novae-Zelandiae*. Part II. *Flowerless plants*. pp. [4]+378. London.

Heincke Expedition (Canary Islands), 1991; *pers. comm.* to D.M. John, 19/11/91, W.F. Prud'homme van Reine, R.J. Haroun & E. Serrao.

Hemsley, W.B. 1885a. II.—Report on the botany of theBermudas and various other islands of the Atlantic and Southern Oceans. [First part] [pp. 1–135+[27]]. *In* C.W. Thompson & J. Murray, *Report on the scientific results of the voyage of H.M.S.* Challenger *during the years 1873–76 under the command of Captain George S. Nares, R.N., F.R.S. and the late Captain Frank Tourle Thompson, R.N...., Botany*—**I**. pp. xi+[1]+75+[1]+135+[27]+299+[81]+333+[25]. London.

—— 1885b. III.—Report on the botany of the Bermudas and various other islands of the Atlantic and Southern Occans. *In* C.W. Thompson & J. Murray, *Report on the scientific results of the voyage of H.M.S.* Challenger *during the years 1873–76 under the command of Captain George S. Nares, R.N., F.R.S. and the late Captain Frank Tourle Thompson, R.N. . . ., Botany*—**I**: 1–299 + [81], London.

Henriques, J.[A] 1885 ['1884']. Contribuiçao para o estudo da flora d'algumas possessões portuguezas I Plantas colhidas por F. Newton na Africa occidental. *Bolm Soc. broteriana* **3**: 129–140.

—— 1886. Algae [pp. 217–221]. *In* J.[A.] Henriques, Contribuiçocs para o estudo da Flora d'Africa Flora de S. Thomé. *Bolm Soc. broteriana* **4**:129–221.

—— 1887. Flora de S. Thomé.—[130]. [pp. 381– 383]. *In* G.B. De Toni & D. Levi, Contributiones ad phycologiam extra-italicam. *Notarisia* **2**: 375–383.

Note. A complete extract from Henriques (1886) (263); the present text has been attributed to Henriques solely, as there appear to be no alterations in the algal text.

——1917. Catálogo das espécies de animais e plantas até hoje encontradas na ilha de S. Tomé. *Bolm Soc. broteriana* **27**: 138–197.

Henriques, I. [J.] [A.], [De Toni, G.B. & Levi, D.] 1886. Contribuçao para o estudo da flora d'algunas possessões portuguezas. Plantas colhidas por F. Newton na Africa occidental. (*del Boletim da Sociedade Broteriana* III–IV p.129—Coimbra 1885). Algae [pp. 121–122]. *In* De Toni, G.B. & Levi, D., Contributiones ad Phycologiam extra-italicam. *Notarisia* **1** (2): 117–122.

Heydrich, F. 1894. Beiträge zur Kenntniss der Algenflora von Ost-Asien besonders der Insel Formosa, Molukken- und Liu-Kiu-Inseln. *Hedwigia* **33**: 267–306.

Hoek, C. van den 1982. The distribution of benthic marine algae in relation to

the temperature regulation of their life histories. *Biol. J. Linn. Soc.* **18**: 81–144.

Hoppe, H.A. 1969. Marine algae as raw materials [pp. 126–287]. *In*: T. Levring, H.A. Hoppe & O.J. Schmid, *Marine algae A survey of research and utilization*. Botanica Marina Handbooks **1**. pp. [8]+421. Hamburg.

Irvine, L.M. 1983. *Seaweeds of the British Isles. . .*, Vol. 1*Rhodophyta* Part 2A *Cryptonemiales (sensu stricto)*, *Palmariales*, *Rhodymeniales*. pp. xii+115. London.

Jardin, E. 1851(?). *Herborisations sur la Côte Occidentale d'Afrique pendant les Années 1845–1846–1847–1848*. pp. [4]+19. Paris.

Note. A pair of extracts from the July 1850 and May 1851 numbers of *Nouvelles Annales de la Marine et des Colonies*. Texts clearly repaged, but division of present text probably represents at least the break between the parts as originally published, pp. 1–8 and pp. 9–19.

—— 1875. Énumération de nouvelles plantes phanerogames et cryptogames découvertes dans l'Ancien et le Nouveau Continent et recueillies par Edélestan Jardin. *Bull. Soc. linn. Normandie* sér. 2, **9**: 247–339, 1874–75.

Johansen, H.W. 1981. *Coralline algae, a first synthesis*. pp.[10] + 239. Boca Raton, Florida.

—— **& Silva, P.C.** 1978. Janieae and Lithotricheae: two new tribes of articulated Corallinaceae (Rhodophyta). *Phycologia* **17**: 413–417.

—— **H.W. & Womersley, H.B.S.** 1986. *Haliptilon roseum* (Corallinaceae, Rhodophyta) in southern Australia. *Aust. J. Bot.* **34**: 551–567.

John, D.M. 1972. The littoral ecology of rocky parts of the north-western shore of the Guinea Coast. *Botanica mar.* **15**: 199–204.

—— 1977 ['1976']. The marine algae of Ivory Coast and Cape Palmas in Liberia (Gulf of Guinea). *Revue algol.* N.S. **11**: 303–324.

—— 1986. Littoral and sub-littoral marine vegetation [pp. 215–246]. *In* G.W. Lawson (ed.), *Plant Ecology in West Africa: Systems and Processes*. New York, Chichester, Brisbane & Toronto.

—— **& Asare, S.O.** 1975. A preliminary study of the variations in yield and properties of phycocolloids from Ghanaian seaweeds. *Mar. Biol. Berl.* **30**: 325–330.

—— **& Lawson, G.W.** 1972a ['1971']. Additions to the marine algal flora of Ghana I. *Nova Hedwigia* **21**: 817–841.

—— **& Lawson, G.W.** 1972b. The establishment of a marine algal flora in Togo and Dahomey (Gulf of Guinea). *Botanica mar.* **15**: 64–73.

—— **& Lawson, G.W.** 1974. Observations on the marine algal ecology of Gabon. *Botanica mar.* **17**: 249–254.

—— **& Lawson, G.W.** 1977a. The marine algal flora of the Sierra Leone Peninsula. *Botanica mar.* **20**: 127–135.

—— **& Lawson, G.W.** 1977b. The distribution and phytogeographical status of the marine algal flora of Gambia. *Feddes Reprium* **88**: 287–300.

—— **& Lawson, G.W.** (not published). Additions to the marine algal flora of Ghana II.

Note Originally submitted to *Nova Hedwigia* and reached page-proof, 21 Sept. 1972. Corrected and returned from Ghana, but no more heard of paper and never published. Revised dated by authors to 1973, 1974 and (finally before being abandoned) 1975. Much of the included information used subsequently elsewhere, but a few data not taken up and hence the present inclusion.

—— **& Pople, W.** 1973. The fish grazing of rocky shore algae in the Gulf of Guinea. *J. exp. mar. Biol. Ecol.* **11**: 81–90.

——, **Lawson, G.W. & Price, J.H.** 1981. Preliminary results from a recent survey of the marine algal flora of Angola (Southwestern Africa). *Proc. int. Seaweed Symp.* **8**: 367–371.

——, **Lieberman, D. & Lieberman, M.** 1977. A quantitative study of the structure and dynamics of benthic subtidal algal vegetation in Ghana (Tropical West Africa). *J. Ecol.* **65**: 497–521.

——, **Lieberman, D., Lieberman, M. & Swaine, M.D.** 1980. Strategies of data collection and analysis of subtidal vegetation [pp. 265–284]. *In* J.H. Price, D.E.G. Irvine & W.F. Farnham (eds), *The Shore Environment*. Vol. 1: *Methods*. Systematics Association Special Volume 17(a). pp. x+321+[1]+II–IIC. London, New York, Toronto, Sydney, San Francisco.

——, **Price, J.H., Maggs, C. & Lawson, G.W.** 1979. Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. III. Rhodophyta (Bangiophyceae). *Bull. Br. Mus. nat. Hist. (Bot.)*, **7**: 69–82.

J[ohnston], C.S. 1966. Marine biological survey.[pp.43–54]. Ecological reports. [pp.55–119]. *In* Johnston, C.S. (ed.), *Canary Island Biological Expedition 1965 A scientific expedition to the Canary Island of Lanzarote organised by the Heriot Sub-aqua Club, Edinburgh,* Expedition Report, Vol. I, pp. [2] + 132, Edinburgh.

Johnston, C.S. 1969a. Studies on the ecology and primary production of Canary Islands marine algae. *Proc. int. Seaweed Symp.* **6**: 213–222.

—— 1969b. The ecological distribution and primary productivity of marine benthic algae of Lanzarote in the eastern Canaries. *FAO Fish. Rep.* **68**: 37–38 [Abstract].

—— 1969c. The ecological distribution and primary production of macrophytic marine algae in the eastern Canaries. *Int. Rev. ges. Hydrobiol.* **54**: 473–490.

Jorge, D., Gonzales, M.N. & Delgado, E. 1986 ['1984']. Macrofitobentos del litoral del Puerto de Las Nieves (Gran Canaria). *Botanica Macaronesica* **12–13**: 111–122.

Kensley, B. & Penrith, M.–L. 1980. The constitution of the fauna of rocky intertidal shores of South West Africa. Part III. The north coast from False Cape Frio to the Kunene River. *Cimbebasia* ser. A, **5**: 201–214.

Knauss, M.E. & Hommersand, M.H. 1989. Vegetative and reproductive development of *Halarachnion ligulatum* (Gigartinales, Rhodophyta). *Br. Phycol. J.* **24**: 39–52.

Kornmann, P. & Sahling, P.-H. 1977. Meeresalgen von Helgoland.Benthische Grun-, Braun- und Rotalgen. *Helgolander wiss. Meeresunters.* **29**: 1–289.

Kützing, F.T. 1849. *Species algarum*. pp. VI+922. Lipsiae.

—— 1864. *Tabulae phycologicae oder Abbildungen der Tange*. Bd. **14**, pp. [1]+35+pls1–100. Nordhausen.

—— 1865. *Tabulae phycologicae oder Abbildungen der Tange*. Bd. **15**, pp. [1]+36+pls1-100. Nordhausen.

Lawson, G.W. 1953. The general features of seaweed zonation on the Gold Coast. *Proc. int. Seaweed Symp.* **1**: 18–19.

—— 1954. Seaweeds from Sierra Leone. *Jl W. Afr. Sci. Ass.* **1**(1): 63–67.

—— 1955. Rocky shore zonation in the British Cameroons. *Jl W. Afr. Sci. Ass.* 1(2): 78–88.

—— 1956. Rocky shore zonation on the Gold Coast. *J. Ecol.* **44**: 153–170.

—— 1957. Some features of intertidal ecology of Sierra Leone. *Jl W. Afr. Sci. Ass.* **3**: 166–174.

—— 1957. Seasonal variation of intertidal zonation on the coast of Ghana in relation to tidal factors. *J. Ecol.* **45**: 831–860.

—— 1960. A preliminary check-list of Ghanaian fresh- and brackish-water algae. *Jl W. Afr. Sci. Ass.* **6**: 122–136.

—— 1966. The littoral ecology of West Africa. *Oceanogr. mar. Biol. ann. Rev.* **4**: 405–448.

—— 1980. Unpublished list (*in litt.*) of benthic marine algae from the intertidal and shallow subtidal of Fernando Poo (Bioko) collected during a field trip in December 1980.

—— **& John, D.M.** 1977. The marine flora of the Cap Blanc peninsula: its distribution and affinities. *Bot. J. Linn. Soc.* **75**: 99–118.

—— **& John, D.M.** 1982. The Marine Algae and Coastal Environment of Tropical West Africa. *Beih. Nova Hedwigia* **70**. pp. 455. Vaduz.

—— **& John, D.M.** 1987. The marine algae and coastal environment of tropical West Africa (second edition). *Beih. Nova Hedwigia* **93**. pp. vi + 415, Vaduz.

Note See note to ed. 1, 1982.

—— **& Norton, T.A.** 1971. Some observations on littoral and sublittoral zonation at Teneriffe (Canary Isles). *Botanica mar.* **14**: 116–120.

—— **& Price, J.H.** 1969. Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. I. Chlorophyta and Xanthophyta. *Bot. J. Linn. Soc.* **62**: 279–346.

——, **John, D.M. & Price, J.H.** 1975. The marine algal flora of Angola: its distribution and affinities. *Bot. J. Linn. Soc.* **701: 307–324.**

——, **John, D.M. & Price, J.H.** 1992. The marine algal flora of St. Helena: its distribution and biogeographical affinities. *Cour. Forsch.-Inst. Senckenberg* **105**: 35–49.

——, **Simons, R.H. & Isaac, W.E.** 1990. The marine algal flora of Namibia: its distribution and affinities. *Bull. Br. Mus. nat. Hist.(Bot.)* **20**(2): 153–168.

Lemoine, P. 1915. Calcareous algae. *Rep. Dan. oceanogr. Exped. Mediterr.* Biology K.1, **II**: 1–30.

—— 1917. Fam. 5. *Corallinaceae*. Subfam. 1. Melobesieae [pp. 147–182]. *In* F. Borgesen, The marine algae of the Danish West Indies Vol. 2. Rhodophyceae [pt. 3]. *Dansk bot. Ark.* **3**(1c): 145–240.

—— 1917. Les Mélobésiées des Antilles Danoises récoltées par M. Boergesen. *Bull. Mus. Hist. nat. Paris* **23**: 133–136.

—— 1924. Corallinacées du Maroc [I]. *Bull. Soc. Sci. nat. Maroc* **4**: 113–134.

—— 1929. Les Mélobésiées [Subfam. 1. Melobesieae] [pp. 19–68]. *In* F. Borgesen, Marine algae from the Canary Islands especially from Teneriffe and Gran Canaria III. Rhodophyceae Part II Cryptonemiales, Gigartinales and Rhodymeniales. *K. danske Vidensk. Selsk., Biol. Medd.* **8**(1): 1–97+[9].

Levring, T. 1969. The vegetation in the sea [pp. 1–46]. *In* T. Levring, H.A. Hoppe & O.J. Schmid, *Marine algae A survey of research and utilization*. Botanica Marina Handbooks **1**. pp. [8]+1–421. Hamburg.

—— 1974. The marine algae of the archipelago of Madeira. *Bolm Mus. munic. Funchal 28(125): 1–111.*

Lieberman, M., John, D.M. & Lieberman, D. 1979. Ecology of subtidal algae on seasonally devastated cobble substrates off Ghana. *Ecology* **60**: 1151–1161.

——, **John, D.M. & Lieberman, D.** 1984. Factors influencing algal species assemblages on reef and cobble substrata off Ghana. *J. exp. mar. Biol. Ecol.* **75**: 129–143.

Longhurst, A.R. 1958. An ecological survey of the West African marine benthos. *Fishery Publs colon. Off. London* **11**: 1–102.

López Hernández, M. & Gil-Rodríguez, M.C. 1982 ['1981']. Estudio de la vegetación ficologica del litoral comprendido entre Cabezo del Socorro y

Montaña de la Mar, Güímar, Tenerife. *Vieraea* **11**: 141–170.

Lüning, K. 1985. *Meeresbotanik Verbreitung, Ökophysiologie und Nutzung der marinen Makroalgen*. pp. vii + [1] + 375. Stuttgart & New York.

Maggs, C.A. 1983. *A phenological study of the epiflora of the maerl beds in Galway Bay*. Ph.D Thesis, University College, Galway.

Marcot-Coqueugniot, J. 1991. A preliminary list of marine algae from the Banc d'Arguin (Mauritania). *Botanica mar.* **34**: 195–199.

Martens, G. von 1866. *Die Preussische Expedition nach Ost-Asien. Nach amtlichen Quellen. Botanischer Theil. I. Die Tange*. pp. [4]+1–152. Berlin.

Martin Aguado, M. 1957. Las algas de Canarias en la obra científica de Viera y Clavijo. *An. Univ. La Laguna, Facult. Filos. Letr.*, **1957**: 6–52.

Mazza, A. 1905–1925. Saggio di algologia oceanica *Nuova Notarisia* **16**: 85–101, 129–141, 1905; **17**: 1–13. 41–56, 81–101, 129–150, 1906; **18**: 1–36, 65–98, 126–152, 177–195, 1907; **19**: 1–24, 49–66, 109–129, 153–170, 1908; **20**: 6–18, 65–86, 113–135, 1909; **21**: 1–27, 65–99, 125–152, 169–199, 1910; **22**: 7–25, 1911; **22**: 53–80, 1912; **23**: 1–24,57–78, 109–122, 1912; **24**: 57–85, 1913; 157–174, 1914; **27**: 1–53, 104–155, 169–215, 1916;. **28**:176–239, 1917; Aggiunte al saggio di algologica oceanica (Florideae). *Nuova Notarisia* **30**: 1–62, 1919; **31**: 93–160, 1920; **32**: 1–48, 1921; **33**: 97–125, 1922.

Note. Series continues, without relevant records, to 1925. H–K relevance in volumes **21** and **24** only.

Meñez, E.G. & Mathieson, A.C. 1981. The marine algae of Tunisia. *Smithson. Contrib. mar. Sci.* **10**: i–viii+1–59.

Michanek, G. 1971. *A preliminary appraisal of world seaweed resources*. FAO Fisheries Circular, **128**: [2]+ii+37 Rome.

—— 1975. *Seaweed resources of the ocean* FAO Fisheries Technical Paper, **138**: v+[1]+127 Rome.

—— 1983. 4. World resources of marine plants 4.1 Benthic Plants. [pp. 795–831; 833–897]. *In* Kinne, O. (ed.), *Marine ecology*. . . Vol. V. *Ocean management* Part 2: *Ecosystems and organic resources*. pp. xiii + [5] + 643–1090. Chichester, N.Y., Brisbane, Toronto & Singapore.

Millar, A.J.K. 1990. Marine red algae of Coffs Harbour region, northern New South Wales. *Austr. Syst. Bot.* **3**: 293–593.

Mollion, J. 1973. Étude préliminaire des *Hypnea* au Sénégal comme source de phycocolloides. *Botanica mar.* **16**: 221–225.

—— 1976 ['1975']. Étude quantitative d'une formation végétale marine de l'infralittoral supérieur au Sénégal. *Bull. Inst. fond. Afr. noire* sér. A **37**: 537–554.

—— 1978. Seasonal variation in carrageenan from *Hypnea musciformis* (Floridiophyceae) in Sénégal. *Proc. int. Seaweed Symp.* **9**: 233–240.

Montagne, [J.F.] C. 1839–1841 ['1835–50']. Plantes cellulaires [**3**(2): pp. I–XV+[1]+1–208]. *In* P. Barker-Webb & S. Berthelot, *Histoire Naturelle des Iles Canaries*. . . **3**(2), *Phytographia Canariensis, Sectio ultima. [4]+XV+[1]+208 pp. Paris.*

Note. For detailed consideration of the bibliography of this work see Stearn in *J. Soc. Biblphy nat. Hist.* **1**: 49–63 (1937). The correct date of publication is probably 1841; the Introduction by Montagne is dated Paris, 1/1/1841.

—— 1842. Troisième centurie de Plantes cellulaires exotiques nouvelles. *Annls Sci. nat.* (Bot.), sér. 2, **18**: 241–282.

—— 1846a. Ordo 1. Phyceae Fries [pp. 1–197]. *In* Durieu de Maissonneuve, [M.C.], *Flore d'Algérie. Cryptogamie. Première Partie*. pp. [6]+II+631. Paris, 1846–1849.

—— 1846b. Cryptogamae cellulares. Classis I. Phyceae (I) Fries. [pp. 1–112]. *In* Gaudichaud, C., *Voyage autour du Monde exécuté pendant les années 1836 et 1834 sur la corvette La Bonite . . . Botanique* . . . Tome I *Cryptogames cellulaires et vasculaires* . . pp.[6] + xi + 355. Paris.

—— 1860. Florula Gorgonea seu enumeratio plantarum cellularium quas in promontorio Viridi (*cap Vert*) insulisque adjacentibus a diversis botanicis et imprimis Cl. Bolle, berolinensi, hucusque collectas, recognovit descripsitque. *Annls Sci. nat.* (Bot.), sér. 4, **14**: 210–225.

Mshigeni, K.E. 1977. Seasonal changes in the standing crops of three *Hypnea* species (Rhodophyta: Gigartinales) in Hawaii. *Botanica mar.* **20**: 303–306.

Murray, G. 1888–89. Catalogue of the marine algae of the West Indian region. *J. Bot. Lond.* **26**: 193–196, 237–243, 303–307, 331–338, 358–363, 1888; **27**: 237–242, 257–262, 298–305, 1889.

Note. Re-paged reprints of the continuous text, pp. 1–46 [1888, pp. 1–28; 1889, pp. 28–46].

Naegelé, A. 1960. Note sur le peuplement algal de la presqu'ile du Cap-Vert. *Notes afr.* **88**: 118–119.

Niell, [F.] X. 1974. Les applications de l'Indice de Shannon à l'étude de la végétation intertidale. *Bull. Soc. phycol. Fr.* **19**: 238–254.

Otero-Schmitt, J., Collections from Cape Verde Islands (637 and 641), determined by collector and confirmed (637) by W.F. Prud'homme van Reine or unchecked (641); all pers. comm. from Prud'homme van Reine to D.M. John, 19/11/91.

Palminha, F. 1960. Sobre a prospecção algológica com fis industriais efectuada no archipélago de Cabo Verde Companha Oceanográfica do N.O. 'Baldaque da Silva' no ano de 1958. *Notas mimeogr. Centro Biol. Piscat., Lisboa* **11**: [1]+1–7.

—— 1961. A existência de algas agarófitas cm Angola. *Notas mimeogr. Centro. Biol. Piscat., Lisboa* **16**:

——, Torres, L. & Granger, R. 1963. Uma alga de provável interesse económico na Baía de Benguela (*Hypnea benguelensis* nov. sp.). *Notas mimeogr. Centro. Biol. Piscat., Lisboa* **37**: [2]+1–21+[2].

Parkinson, P.G.. 1980. *Halymenia. Phycologia Historiae Analecta Autodidactica Fasciculus Primus*. pp. 20. Auckland, New Zealand.

Penrith, M.-L. & Kensley, B.F. 1970a. The constitution of the intertidal fauna of rocky shores of South West Africa. Part I. Lüderitzbucht. *Cimbebasia* ser. A, **1**: 189–239.

—— **& Kensley, B.[F].** 1970b. The constitution of the fauna of rocky intertidal shores of South West Africa. Part II. Rocky Point. *Cimbebasia* scr. A, **1**: 241–268.

Penrose, D. 1991. *Spongites fruticulosus* (Corallinaceae, Rhodophyta), the type species of *Spongites*, in southern Australia. *Phycologia* **30**: 438–448.

—— **& Woelkerling, W.J.** 1992. A reappraisal of Hydrolithon and its relationship to Spongites (Corallinaceae. Rhodophyta). *Phycologia* **31**: 81–88.

Perez-Cirera, J.L. 1973. Datos sobre la flora algológica bentónica de Cabo Raso (Portugal). *Anales Instituto bot. Ant. José Cavanilles* **30**: 5–13.

—— 1975a. Catalogo floristico de las algas bentonicas de la Ria di Corme y Lage, NO. de España. *Anales Instituto bot. Ant. José Cavanilles* **32**(1): 1–87.

—— 1975b. Catalogo floristico de las algas bentonicas de la Ria de Cedeira, NO. de Espana. *Anales Instituto bot. Ant. José Cavanilles* **32**(2): 53–74.

Piccone, A. 1884. *Crociera del Corsaro alle Isole Madera e Canarie del Capitano Enrico d'Albertis Alghe*. 60 pp. Genova.

—— 1885. Notizie preliminari intorno alle alghe della 'Vettor Pisani' raccolte dal Sig. C. Marcacci. Lettera di A. Piccone. *Nuovo G. bot. Ital.* **17**: 185–188.

—— 1886a. Nota sulle raccolte algologiche fatte durante il viaggio di circumnavigazione compinto dalla R. Corvetta VETTOR PISANI. *G. Soc. Lett. Conv. scientif. Genova, sez. Geogr.*, **9**: 159–163.

—— 1886b. Nota sulle raccolte algologiche fatte durante il viaggio di circumnavigazione compinto della R. Corvetta 'Vettor Pisani'.— [30]. *Notarisia* **1**(3): 150–151.

Note. Repeats verbatim the data on Cape Verde Island collections from Piccone (442). The '[30]' in the title is a reference to the entry in the 'Litteratura Phycologica' list on pp. 148–150 of the same issue.

—— 1887a. *Alghe del viaggio di circumnavigazione della Vettor Pisani*. 97 pp. Genova.

Note. See Piccone (446) for repeated data.

—— 1887b. *Alghe del viaggio di circumnavigazione della Vettor Pisani*—[] Elenchi parziali delle alghe raccolte nelle diverse località [pp. 283–287]. *In* G.B. De Toni & D. Levi, Contributiones ad phycologiam extra-italicam. *Notarisia* **2**: 283–291.

Note. This work is, as far as can be determined, an exact copy of the text in Piccone (445). The latter is therefore credited with authorship.

—— 1890 ['1889']. Nuove alghe del viaggio di circumnavigazione della 'Vettor Pisani'. *Atti Accad.naz. Lincei Memorie*, ser. 4, **6**: 10–63.

—— 1900. Noterelle ficologiche. XI. Pugillo di alghe dell'isola S. Thiago (Capo Verde). *Atti Soc. ligust. Sci. nat. geogr.* **11**: 238–239.

Note. Also reproduced in Piccone (451).

—— 1901. Noterelle ficologiche XI.—Pugillo di alghe dell'isola S. Thiago (Capo Verde). *Nuovo Notarisia* **12**: 45–47.

Note. Some data reported from Piccone (450).

Pilger, R. 1911 ['1911–12']. Die Meeresalgen von Kamerun. Nach der Sammlung von C. Ledermann [pp. 294–313, 316–323]. *In* A. Engler, Beiträge zur Flora von Afrika. XXXIX. *Bot. Jb.* **46**: 293–597.

—— 1920 ['1920–21']. Algae Mildbraedianae Annobonenses [pp. 1–14]. *In* A. Engler, Beiträge zur Flora von Afrika. XLVIII. *Bot. Jb.* **57**: 1–301.

Note. See also Pilger (457).

—— 1922. Algae [pp. 157–158]. Algae. Corallinaceae [p. 158]. *In* J. Mildbraed, *Wissenschaftliche Ergebnisse der Zweiten Deutschen Zentral-Afrika- Expedition 1910–1911* . . . Bd 11: *Botanik*. pp. [4]+202. Leipzig.

Note. 'Algae' is a repeat of Pilger (456) and 'Algae. Corallinaceae' of Pilger (455), the latter not being listed here since not relevant to the present part of the listing.

Price, J.H. & John, D.M. 1978. Subtidal ecology in Antigua and Ascension: a comparison. *Progr. underwat. Sci. [Rep. underwater Ass.]* N.S. **3**: 111–133.

—— **& John, D.M.** 1980. Ascension Island, South Atlantic: a survey of inshore benthic macroorganisms, communities and interactions. *Aquatic Bot.* **9**: 251–278.

——, **John, D.M. & Lawson, G.W.** 1978. Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment II. Phaeophyta. *Bull. Br. Mus. nat. Hist.* (Bot.) **6**: 87–182.

——, **John, D.M. & Lawson, G.W.** 1986. Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment IV. Rhodophyta (Florideae) 1. Genera A–F. *Bull. Br. Mus. nat. Hist.* (Bot.) **15**: 1–122.

——, **John, D. M. & Lawson, G. W.** 1988. Seaweeds of the western coast of

tropical Africa and adjacent islands: a critical assessment. IV. Rhodophyta (Florideae) 2. Genera G. *Bull. Br. Mus. nat. Hist.* (Bot.) **18**: 195–273.

Prud'homme van Reine, W.F. (*in litt.* extractions of report on red algal distribution patterns; to JHP, 10.4.87).

Note. The essential basis of the distribution data presented in the communication of 10/4/87 was published in Prud'homme van Reine & van den Hoek (1990), but in such a biogeographical form that the extraction of individual records for named taxa was virtually impossible.

—— *Pers. comm.* to D.M. John, 19/11/91, of reallocations following examination of original Piccone material from the Canary Islands.

—— **& Hoek, C. van den** 1988. Biogeography of Capeverdean seaweeds. *Cour. Forsch.-Inst. Senckenberg* **105**: 35–49.

—— **& Hoek, C. van den** 1990. Biogeography of Macaronesian seaweeds. *Cour. Forsch.-Inst. Senckenberg* **129**: 55–73.

—— **& Pakker, H.** 1991. Collections from Cape Verde Islands; *pers. comm.* authors to D.M. John, 19/11/91.

Rama Rao, K. 1977. Species of *Gracilaria* and *Hypnea* as potential sources of agar. *Seaweed Res. Utiln* **2**: 95–102.

—— 1982. Biology of *Hypnea* species and their possible utilisation in India. *Seaweed Res. Utiln* **5**: 11–19.

Reinbold, T. 1907. Die Meeresalgen der deutschen Tiefsee—Expedition 1898–1899 [pp. 549–586+[8], pls LV–LVIII]. *In* C.Chun, *Wissenschaftliche Ergebnisse der deutschen Tiefsee—Expedition auf dem Dampfer 'Valdivia' 1898–1899*. Bd. **II**, Teil **II**, Lieferung **IV**. pp. 549–586+[8]+pls LV–LVIII. Jena.

—— 1908 ['1928']. Die Meeresalgen der Deutschen Südpolar-Expedition 1901–1903 [Heft II, **1**. pp. [2]+179+202]. *In* E. von Drygalski, *Deutsche Sudpolar-Expedition 1901–1903 im Auftrage des Reichsministeriums des Innern* **8** Botanik. pp. [4]+178+[2]+179–372+[12]+373–715+[27]. Berlin & Leipzig.

Note. 1928 is the publication date of the whole volume and of the last part; the earlier parts were published separately at various dates as completed (1906; 1908; 1911; 1924; 1928).

Rengasamy, R. & Ilanchelian, K. 1988. Seasonal studies on *Hypnea valentiae* (Turn.) Mont. (Gigartinales, Rhodophyta) at Muttukadu near Madras. *Seaweed Res. Utiln* **11**: 21–26.

Ribera Siguán, M. A., Gómez Garreta, A. & Seoane-Camba, J. A. 1985 ['1984']. Estudio biogeográfico de la flora algológica bentónica marina de Las Islas Baleares. *An. Biol. Univ. Murcia* **2** (Secc. Esp. 2): 147–159.

Richardson, W.D. 1969. Some observations on the ecology of Trinidad marine algae. *Proc. int. Seaweed Symp.* **6**: 357–363.

Rodrigues, J.E. de M. 1960. Revisao das algas de S. Tomé e Príncipe do herbário do Instituto Botânico de Coimbra. I—Phaeophyta. *Garcia de Orta* **8**: 583–595.

Round, F.E. 1981. *The ecology of algae*. pp. vii+653. Cambridge, London, New York, New Rochelle, Melbourne & Sydney.

Sansón Acedo, M. 1991. *Estudio de las especies de la familia Ceramiaceae (Rhodophyta) en les Islas Canarias*. Thesis de Doctorado, Universidad de La Laguna, Tenerife, Islas Canarias (unpublished).

Santos Guerra, A. 1972. Contribución al estudio de la flora marina de la Isla de La Gomera. *Vieraea* **2**(1): 86–102.

——, **Acuña G.[onzales], A. & Wildpret [de la Torre], W.** 1970. Contribución al estudio de la flora marina de la Isla de La Palma. *Cuad. Bot. Canar.* **9**: 20–29.

Sanusi, S.S. 1980. *A study on grazing as a factor influencing the distribution of benthic littoral algae*. M.Sc. thesis, University of Ghana, Legon.

Sauvageau, C. 1912. A propos des *Cystoseira* de Banyuls et Guéthary. *Bull. Stn biol. Arcachon* **14**: 133–556.

Note. There also exists a separate, repaged 1–424.

Schenkman, R.P.F. 1989. *Hypnea musciformis* (Rhodophyta); ecological influence on growth. *J. Phycol.* **25**: 192–196.

Schiffner, V. 1931. Neue und bemerkenswerte Meeresalgen. *Hedwigia* **71**: 139–160; 161–205.

Schmidt, O.C. 1924. Index algarum marinarum 1920–1923. *Hedwigia* **65**: 11–27.

—— 1929. Beiträge zur Kenntnis der Meeresalgen der Azoren I. *Hedwigia* **69**: 95–113.

—— 1929. Beiträge zur Kenntnis der Meeresalgen der Azoren II. *Hedwigia* **69**: 165–172.

—— 1931. Die marine Vegetation der Azoren in ihren Grundzügen dargestellt. *Biblithca Bot.* **102**: 1–116.

—— **& Gerloff, J.** 1957. Die marine Vegetation Afrikas in ihren Grundzügen dargestellt. *Willdenowia* **1**: 709–756.

—— **& Falkenberg, P.** 1897. Rhodomelaceae [pp. 421–480; Lief. 149/150]. *In* A. Engler & K. Prantl, *Die natürlichen Planzenfamilien*. . ., **I** Teil. 2. Abteilung. pp. XII+580. Leipzig. 1890–1897.

—— **& Hauptfleisch, P.** 1896–1897a. Sphaerococcaceae [pp. 382–396]. *In* A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien*. . ., **I** Teil. 2. Abteilung. pp. XII+580. Leipzig. 1890–1897.

—— **& Hauptfleisch, P.** 1897b. Rhodymeniaceae [pp. 396–405; Liefs. 149 & 150].*In* A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien* . . ., **I** Teil. 2. Abteilung. pp.XII + 580. Leipzig, 1890–1897.

—— **& Hauptfleisch, P.** 1897c. Grateloupiaceae. [pp.508–514]. *In* A. Engler & K.Prantl, *Die natürlichen Pflanzenfamilien*. . . **I**. Teil. 2. Abteilung. pp. XII + 580. Leipzig, 1890–1897.

Schneider, C.W. 1975. North Caroline marine algae. V. Additions to the flora of Onslow Bay, including the reassignment of *Fauchea peltata* Taylor to *Weberella* Schmitz. *Br. phycol. J.* **10**: 129–138.

—— **& Searles, R.B.** 1991. *Seaweeds of the Southeastern United States Cape Hatteras to Cape Canaveral*. pp. xi+[2]+553+[1]. Durham, North Carolina & London.

Searles, R.B. 1968. Morphological studies of red algae of the order Gigartinales. *Univ. Calif. Publns. Bot.* **43**: vi+[2]+1–100.

Seagrief, S.C. 1984. A catalogue of South African green, brown and red marine algae. *Mem. bot. Soc. S. Africa* **47**: i–iv+1–72.

Seoane-Camba, J. 1960. Nota sobre algunas especies de algas de la costa occidental africana (sur de Cabo Blanco). *Investigación pesq.* **16**: 91–103.

—— 1965. Estudios sobre las algas bentónicas en la costa sur de la Península Iberica (litoral de Cadiz). *Investigación pesq.* **29**: 3–216.

Simons, R.[H]. 1974. Algae, (including diatoms and seaweeds). [pp. 239–261]. *In* J.H. Day, N.A.H. Millard, & M.-L. Penrith (eds), *A Guide to marine life on South African shores*. Second (revised) edition. pp. [4]+i–iii+[1]+300. Cape Town & Rotterdam.

Note. The first edition (not seen) was probably 1969, since that is the copyright date and the preface is dated April 1968. Overall tripartite editorship is obvious from both copyright allocation and statement in preface. Latter also clearly indicates responsibility of R.H. Simons for Algae section. Presumably algal content of first edition was as in second, since preface statement unchanged from past.

Sonder, [O.W.] 1852. Algae [pp. 125–127]. *In* J.A. Schmidt, *Beiträge zur Flora der Cap Verdischen Inseln. Mit Berücksichtigung aller bis jetzt daselbst bekannten wildwachsenden und kultivirten Pflanzen. Nach eigenen Untersuchungen und mit Benutzung der gewonnenen Resultate anderer Reisenden*. [2]+viii+1–356+[1] pp. Heidelberg.

Note. The algal material was sent to Sonder in Hamburg; he worked on the plants and provided both the determinative data and text as printed. Schmidt (the overall editor) added a small terminal section with Cape Verde Islands records.

Sourie, R. 1954a. Contribution à l'étude écologique des côtes rocheuses du Sénégal. *Mém. Inst. fr. Afr. noire* **38**: 1–342+[1].

Note. From the note on p. 117, it is clear that the algae were worked on mainly by J. Feldmann, but that Sourie took account of some of the views of Dangeard as expressed in the latter's memoir on the Cap Vert (Dakar) peninsula algae. Since the exact contribution of the various people involved is in doubt, we have left the reference in the name of Sourie, who seems to have exercised overall authorship.

—— 1954b. Étude écologique sommaire des fond sableux en Baie de Dakar. *Annls Éc. sup. Sci., Dakar* **1**: 141–155.

Note. Sourie stated (p. 141) that many of the specific determinations of algae were by J. Feldmann.

Steentoft, M. 1967. A revision of the marine algae of Sao Tomé and Príncipe (Gulf of Guinea). *J. Linn. Soc.* (Bot.) **60**: 99–146.

Stephenson, T.A. & Stephenson, A. 1972. *Life between tidemarks on rocky shores*. xii+[2]+425 pp. San Francisco.

Suhr, J.N. von 1831. Beschreibung einiger neuen Algen. *Flora, Regensberg* **14**: 673–687;709–716;725–731.

Tittley, I., Irvine, L.M. & Kartawick, T. 1984. *Catalogue of type specimens and geographical index to the collections of Rhodophyta (red algae) at the British Museum (Natural History)*. Part 1 *Corallinales*. pp. 3+1 microfiche of 64 pp. London.

Trochain, J. 1940. Contribution à l'étude de la végétation du Sénégal. *Mém. Inst. fr. Afr. noire* **2**: [1–6]+1–433+[63].

Note. J. Feldmann clearly had a great deal to do with the main determinations on which the algal list (pp. 108–110) was based; since the extent to which the data were accepted or amended by Trochain is not clear, and since there are other parts to the text which seem definitely to have been attributable to Trochain, we have accepted the latter as overall author. For individual comments on species, the more correct authorship citation would undoubtedly be 'Feldmann, J., in Trochain, J.,' etc.

Tseng, C.K., Chang, C.F., Xia, E.Z. & Xia, B.M. 1982. Studies on some marine red algae from Hong Kong [pp. 57–84]. *In* B.S. Morton & C.K. Tseng, *The Marine Flora and Fauna of Hong Kong and Southern China* . . . [Proceedings of the First International Marine Biological Workshop . . . Hong Kong, 18 April—10 May 1980]. Volume 1. *Introduction and Taxonomy*. pp. viii+554. Hong Kong.

Varo, J., Ramirez, J. & Renteria, J. 1979. Estudio de la vegetación bentonica del litoral granadino. *Acta Bot. Malacitana* **5**: 79–98.

Vickers, A. 1897(?) ['1896']. Contribution à la flore algologiques des Canaries.

Annls Sci. nat. (Bot.), sér. 8, **4**: 293–306.

Note. The date is somewhat difficult to cite as there is confusion regarding the dates of various issues. It does seem possible that pre-prints were issued in 1896 and this is the date usually cited (see Lawson & Price, 1969: 345–346).

Viera y Clavijo, J. de 1866. *Diccionario de Historia Natural de las Islas Canarias, . . . Tomo* **I LXXXI+[1]+[A–G]**. pp. Gran-Canaria.

Note. The background to this work is explained in detail by Martin Aguado (1957) who outlined (p. 8) the career of Viera y Clavijo and the progress of his work. The MS was completed in 1799, with the title *Diccionario de Historia Natural de las Canarias*, but was not published until the indicated dates. See also references 549 and 386. A further version of the work appeared in 1942 under the 'Publicaciones de la Biblioteca Canaria' series (Tenerife). A more recent (1982) new edition was edited by M. Alvar and included an introduction and appendix, with purely historical literary data.

Viera-Rodriguez, M.A. 1987. Contribución al estudio de la flórula bentónica de la isla de La Graciosa. Canarias. *Vieraea* **17**: 237–259.

—— Collections from Canary Islands, determined by collector and *pers. comm.* by W.F. Prud'homme van Reine to D.M. John, 19/11/91.

——, Gil-Rodríguez, M.C., Audiffred, P.A.J., Prud'Homme Van Reine, W.F., Haroun-Tabraue, R. & Wildpret de la Torre, W. 1987. Contribución al estudio de la flórula bentónica del islote de Montaña Clara. Canarias. *Vieraea* **17**: 271–279.

Villena-Balsa, M., Afonso-Carrillo, J. & Wildpret de la Torre, W. 1987. Morfología, estructura y reproducción de una especie epífita del género *Jania* (Corallinaceae, Rhodophyta) de las Islas Canarias. *Vieraea* **17**: 19–42.

Weber-van Bosse, A. 1921. Liste des algues du Siboga II Rhodophyceae Première Partie Protoflorideae, Nemalionales, Cryptonemiales. *In* M. Weber, *Siboga-Expeditie . . . Monographie LIXb. Uitkomsten op zoologisch, botanisch, oceanographisch en geologisch Gebied . . ., Livr. LXXXIX*. pp. [6]+187–392+[4].

Weisscher, F.C.M. 1982. Marine algae from Ilhéu de Fora (Salvage Islands). *Bol. Mus. munic. Funchal* **34**: 23–34.

—— 1983. Marine algae from Selvagem Pcguena (Salvage Islands). *Bol. Mus. munic. Funchal* **35**: 41–80.

Woelkerling, W.J. 1985. A taxonomic reassessmcnt of *Spongites* (Corallinaceae, Rhodophyta) based on studies of Kützing's original collections. *Br. phycol. J.* **20**: 123–153.

Wynne, M.J. 1985. ['1984'] Notes on *Herposiphonia* (Rhodomelaceae, Rhodophyta) in South Africa, with a description of a new species. *Cryptogamie: algologie* **5**:167–177.

—— 1985. Concerning the names *Scagelia corallina* and *Heterosiphonia wurdemannii* (Ceramiales, Rhodophyta). *Cryptogamie: algologie.* **6**: 81–90.

—— 1986. A checklist of benthic marine algae of the tropical and subtropical western Atlantic. *Can. J. Bot.* **64**: 2239–2281.

—— 1986. Report on a collection of benthic marine algae from the Namibian coast (southwestern Africa). *Nova Hedwigia* **43**: 311–355.

—— 1989. The re-instatement of *Hydropuntia* Montagne (Gracilariaceae, Rhodophyta). *Taxon* **38**: 476–479.

—— **& Kraft, G.T.** 1985. *Hypoglossum caloglossoides* sp. nov. (Delesseriaceae, Rhodophyta) from Lord Howe Island, South Pacific. *Br. phycol. J.* **20**: 9–19.

—— **& Norris, R.E.** 1991. *Branchioglossum pygmaeum* sp. nov. and new records of other delesseriaceous algae (Rhodophyta) from Natal, South Africa. *Phycologia* **30**: 262–271.

Yarish, C., Breeman, A.M. & Hoek, C. van den 1985? ['1984']. Temperature, light, and photoperiod responses of some Northeast American and West European endemic rhodophytes in relation to their geographic distribution. *Helgoländer Meeresunters.* **38**: 273–308.

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 147–152 Issued 26 November 1992

Two new species of *Solanum* section *Geminata* (Solanaceae) from Cerro del Torrá in western Colombia

SANDRA KNAPP

Department of Botany, British Museum (Natural History), Cromwell Road, London SW7 5BD

SYNOPSIS. Two new species of *Solanum* section *Geminata* (G. Don) Walp. are described from the Chocó floristic province in western Colombia. *Solanum cyclophyllum* and *S. nematorhachis* are both found on the peaks of the Serrania de los Paraguas on the Chocó/Valle de Cauca border. Relationships of each of the species are briefly discussed.

Recent collecting in the Serrania de los Paraguas on the Chocó/Valle de Cauca border has brought to light two new and interesting species of the large and diverse *Solanum* section *Geminata* (G.Don) Walp. These are described here so the names can be used in floristic and monographic works.

NEW SPECIES DESCRIPTIONS

1. **Solanum cyclophyllum** S. Knapp, sp. nov. Species *Sol. unifoliato* S. Knapp affinis, sed foliis late ovatis, venatione camptodroma nervis ad basin 3-5 jugis differt. Type. Colombia. Chocó: San José del Palmar, Cerro del Torrá, base of E. slope, right edge of heliport, 2000 m, 31 Aug 1988, *Ramos et al.* 1663 (CUVC-holotype; IBE, MO, NY-isotypes).
(Fig. 1)

Shrubs 1–3 m tall; young stems and leaves glabrous; bark of older stems pale yellowish-grey. *Sympodial units* unifoliate. *Leaves* broadly elliptic to orbicular, widest at or just below the middle, glabrous and shining adaxially, glabrous and drying somewhat golden abaxially, with 3–9 pairs of primary veins, the secondary venation conspicuously parallel, lamina 11–21 cm long, 6–19 cm wide, the apex acute, the base acute to rounded; petioles 1–2 cm long. *Inflorescences* opposite the leaves or sometimes internodal, simple, 3–10-flowered, glabrous except for a few reddish papillose trichomes on the tips of the axes; *pedicel scars* closely packed, not overlapping. *Buds* ovoid with pointed tips, *c.* 1/2 exserted from the calyx tube. *Pedicels at anthesis* deflexed, glabrous, 5–7 mm long, *c.* 0.5 mm in diameter at the s deltate to long-triangular, 1–1.5 mm long, glabrous; *corolla* greenish-white to bright green (fide Ramos et al.), 0.7–1 cm in diameter, lobed *c.* 3/4 of the way to the base, the lobes more or less planar at anthesis, the tips and margins of the lobes minutely papillose; *anthers* 2–2.5 mm long, *c.* 1 mm wide, poridical at the tips, the pores lengthening to slits with age; free portion of the *filaments* 0.5–1 mm long, the filament tube 0.25–0.5 mm long, glabrous; *ovary* glabrous; *style* straight, 4–5 mm long, glabrous; *stigma* capitate, the surface minutely papillose. *Fruit* a globose, green to greenish-white berry, 1–1.5 cm in diameter; fruiting pedicels woody, erect, 1–1.5 cm long, 1.5–2 mm in diameter at the base. *Seeds* dark brown, ovoid-reniform, 4–4.5 mm long, 2–2.5 mm wide, the surfaces minutely pitted. *Chromosome number* not known.

DISTRIBUTION. Western Colombia in the departments of Chocó and adjacent Valle de Cauca, 800 to 2000 m, in wet cloud forest (Fig. 2).

SPECIMENS EXAMINED. **Colombia**. Chocó: Nóvita, N. slope of Cerro del Torrá, ridge to W. of Río Surama, trail to Alto de Oso, 600–900 m, 22 Feb 1977, *Forero et al.* 3175 (COL, MO); San José del Palmar, Cerro del Torrá, E slope, near edge of heliport, 1600 m, 26 Aug 1988, *Ramos et al.* 1603 (CUVC, MO, NY). Valle: Bosque de San Antonio, W. of Cali, near television tower, 1950–2050 m, 15 Jul 1984, *Gentry et al.* 48121 (MO, NY); old road to Buenaventura kms 14–18, above Saladito, *c.* 1800 m, 21 Oct 1987, *Ramos* 803 (CUVC, MO, NY); El Cairo, Cerro del Inglés, Serrania de los Paraguas, Cordillera Occidental, Valle-Chocó border 1 hour by jeep from El Cairo, 2070–2400 m, 1 Apr 1988, *Silverstone-Sopkin et al.* 3946 (CUVC, MO, NY).

Solanum cyclophyllum is a member of the *unifoliatum* species group, a small group of 6 species confined to the Chocó floristic province. It is closely related to both *S. unifoliatum* S. Knapp of the Río Atrato drainage and *S. triplinervium* Morton of Isla Gorgona and in some ways is almost intermediate between them. *Solanum cyclophyllum* has leaves with three to five main veins from the base, like *S. triplinervium*, but lacks the distinctive almost Melastomataceous secondary venation of that species. The broadly elliptic to orbicular leaves of *S. cyclophyllum* (from which the epithet is derived) immediately distinguish it from *S. unifoliatum*.

2. **Solanum nematorhachis** S. Knapp, sp. nov. Species *Sol. leptorhachidi* Bitter similis, sed foliis pubescentibus, inflorescentiis et floribus maioribus differt. Type. Colombia. Chocó: San José del Palmar, Cerro del Torrá, E. slope between the heliport and the summit, 2000–2400 m, 28 Aug 1988, *Silverstone-Sopkin et al.* 4846 (CUVC-holotype; CHOCO, MO, NY-isotypes).
(Fig. 3)

Shrubs, 1–3 m tall; young stems and leaves densely pubescent

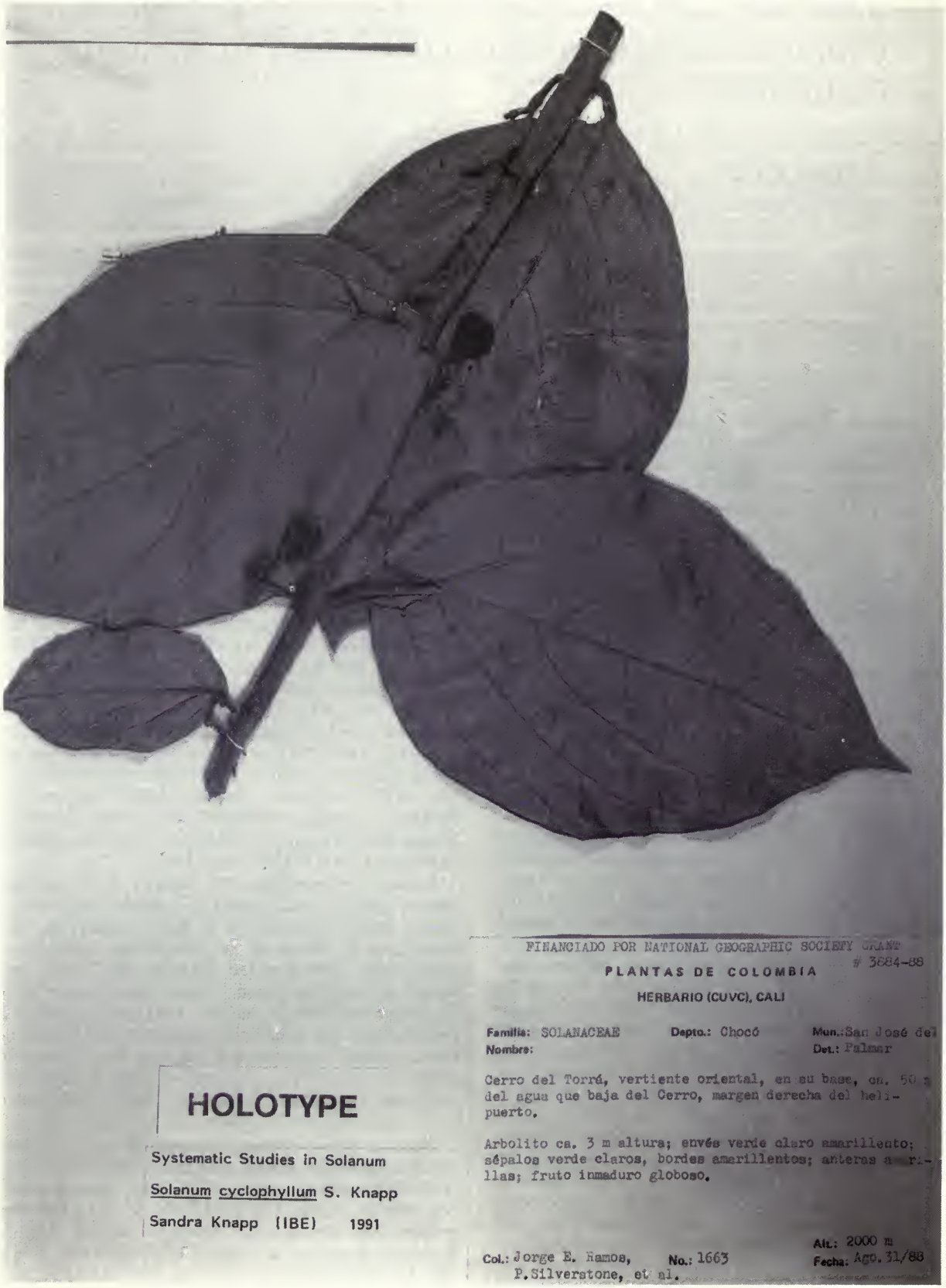
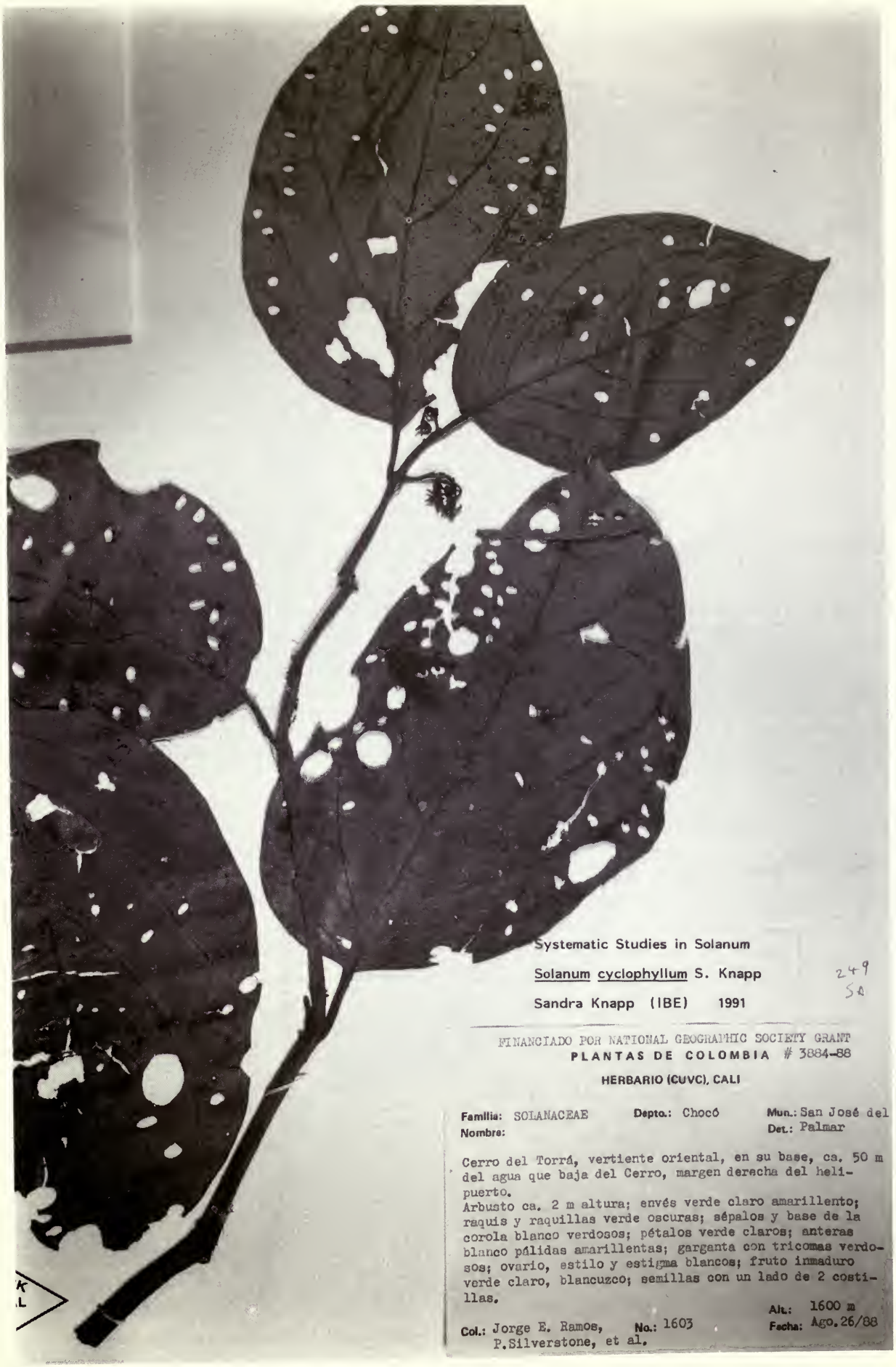

HOLOTYPE
Systematic Studies in Solanum
Solanum cyclophyllum S. Knapp
Sandra Knapp (IBE) 1991
FINANCIADO POR NATIONAL GEOGRAPHIC SOCIETY GRANT
3684-88
PLANTAS DE COLOMBIA
HERBARIO (CUVC), CALI
Familia: SOLANACEAE
Depto.: Chocó
Mun.: San José del
Nombre:
Det.: Palmer
Cerro del Torrá, vertiente oriental, en su base, ca. 50 m
del agua que baja del Cerro, margen derecha del heli-
puerto.
Arbolito ca. 3 m altura; envés verde claro amarillento;
sépalos verde claros, bordes amarillentos; anteras a ri-
llas; fruto inmaduro globoso.
Alt.: 2000 m
Col.: Jorge E. Ramos, P. Silverstone, et al.
No.: 1663
Fecha: Ago. 31/88

Fig. 1 (a) Holotype of *Solanum cyclophyllum* S. Knapp (*Ramos et al. 1663*, CUVC); (b) paratype of *Solanum cyclophyllum* S. Knapp (*Ramos et al. 1603* , NY).


Systematic Studies in Solanum
Solanum cyclophyllum S. Knapp
Sandra Knapp (IBE) 1991
249
SA
FINANCIADO POR NATIONAL GEOGRAPHIC SOCIETY GRANT
PLANTAS DE COLOMBIA # 3884-88
HERBARIO (CUVC), CALI
Familia: SOLANACEAE
Nombre:
Depto.: Chocó
Mun.: San José del
Det.: Palmar
Cerro del Torrá, vertiente oriental, en su base, ca. 50 m del agua que baja del Cerro, margen derecha del helipuerto.
Arbusto ca. 2 m altura; envés verde claro amarillento; raquis y raquillas verde oscuras; sépalos y base de la corola blanco verdosos; pétalos verde claros; anteras blanco pálidas amarillentas; garganta con tricomas verdosos; ovario, estilo y estigma blancos; fruto inmaduro verde claro, blancuzco; semillas con un lado de 2 costillas.
Alt.: 1600 m
Col.: Jorge E. Ramos, P.Silverstone, et al.
No.: 1603
Fecha: Ago.26/88

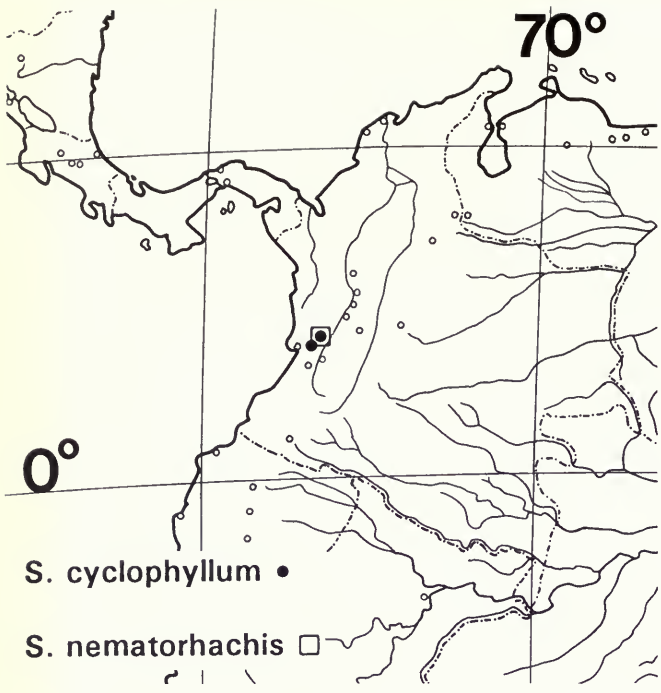


Fig. 2 Distribution of *S. cyclophyllum* and *S. nematorhachis*.

with golden curl-tipped trichomes *c.* 0.5 mm long; bark of older stems dark brown, glabrous or only sparsely pubescent. *Sympodial units* unifoliate. *Leaves* elliptic, with 8–9 pairs of brochiodromus primary veins, glabrous but with a few scattered golden uniseriate trichomes along the midrib adaxially, sparsely to densely pubescent with golden trichomes along the main veins abaxially, 8.5–17 cm long, 2.5–8 cm wide, the apex acuminate, the base acute, not winged onto the petiole; petiole *c.* 0.5 mm long. *Inflorescences* opposite the leaves or internodal, simple, glabrous to sparsely puberulent at the tip, 6–17 cm long, 30–60-flowered, but bearing only two or three flowers at a time; *pedicel scars* widely and unevenly spaced 4–5 mm apart. *Buds* globose, the corolla exserted from the calyx tube. *Pedicels at anthesis* deflexed, glabrous, filiform, 5–8 mm long, *c.* 0.25 mm in diameter at the base. *Flowers* with the *calyx* tube conical to somewhat cyathiform and swollen (Cerro Inglés), 0.5–1.5 mm long, the lobes deltoid, *c.* 0.5 mm long, glabrous or sparsely pubescent with uniseriate trichomes like those of the stems and leaves; *corolla* white, 7–8 mm in diameter, lobed nearly to the base, the lobes more or less reflexed at anthesis, minutely papillose at the tips and margins; *anthers* 1.5–2.5 mm long, *c.* 1 mm wide, poricidal at the tips, the pores tear-drop-shaped; free portion of the *filaments c.* 0.5 mm long, the filament tube *c.* 0.25 mm long; *ovary* glabrous; *style* straight, glabrous, *c.* 4 mm long; *stigma* capitate, the surface minutely papillose. *Fruit* a globose, green berry, *c.* 1.5 cm in diameter when fresh, 1–1.2 cm in diameter dried; *fruiting pedicels* woody, deflexed, 1.5–2 cm long, *c.* 1.5 mm in dimaeter at the base, 4 mm in diameter at the apex. *Seeds* dark brown, ovoid-reniform, 3.5–4 mm long, 2.5–3 mm wide, the surfaces smooth to minutely pitted. *Chromosome number* not known.

DISTRIBUTION. In the Serrania de los Paraguas on Cerros Torrá and Inglés, on the Chocó/Valle border from 2000 to 2400 m (Fig. 2).

SPECIMENS EXAMINED. **Colombia.** Chocó: San José del Palmar, Cerro del Torrá, W. slope, below the heliport at base of cerro, Río Negro drainage, 1680–1940 m, 10 Aug 1988, *Ramos et al.* 1111 (CUVC, MO, NY). Valle de Cauca: S. slope of Cerro Inglés (Cordillera Occidental, Serrania de los Paraguas), 1 hour in jeep from El Cairo, 2260 m, 5 Jan 1987, *Silverstone-Sopkin et al.* 2975 (CUVC, MO, NY).

Solanum nematorhachis is very similar to and probably closely related to *S. leptorhachis* Bitter of low to middle elevation western Ecuador. It differs from *S. leptorhachis* in its pubescent leaf surfaces and inflorescences, white flowers, and much shorter fruiting pedicels. *Solanum tenuiflagellatum* Bitter ex S. Knapp of montane coastal Venezuela also has elongate inflorescences and pubescent leaves, but its flowers are much smaller and the fruiting pedicels are more elongate than those of either *S. leptorhachis* or *S. nematorhachis*.

The extreme length of the inflorescence in *S. nematorhachis* may be related to its fruit dispersal. The hard green fruits of many species of section *Geminata* are dispersed by bats and are taken on the wing. The long inflorescence effectively extends the fruiting pedicel length, perhaps making the fruit itself easier to find in the dense rainforest understory. Only one or at most two fruits seem to develop on each inflorescence in *S. nematorhachis* (also in *S. leptorhachis* and *S. tenuiflagellatum*), perhaps suggesting an andromonoecious breeding system (Whalen & Costich, 1986). This however, as in many other species of section *Geminata* (Knapp, 1986b; 1991), needs to be tested in the lab and in the field.

ACKNOWLEDGEMENTS. I thank the curators of CUVC for their kind loan and gifts of material of these species and the curators of other herbaria mentioned in the text for loan of material. Specimens from Cerro del Torrá were collected by staff of CUVC on an expedition financed by National Geographic Grant no. 388–88.

REFERENCES

Knapp, S. 1986a. A revision of *Solanum* section *Geminata* (G.Don) Walpers. Ph.D. thesis, Cornell University.

—— 1986b. Reproductive biology of *Solanum* section *Geminata* in a Costa Rican cloud forest. *In*: W.G. D'Arcy (Ed.). *Solanaceae: Systematics and Biology*: 253–263. New York.

—— 1991. A revision of the *Solanum sessile* species group (section *Geminata pro parte*: Solanaceae). Bot. J. Linn. Soc. 105: 179–210.

Whalen, M.D. & Costich, D.E. 1986. Andromonoecy in *Solanum*. *In*: W.G. D'Arcy (Ed.). *Solanaceae: Systematics and Biology*: 284–302. New York.

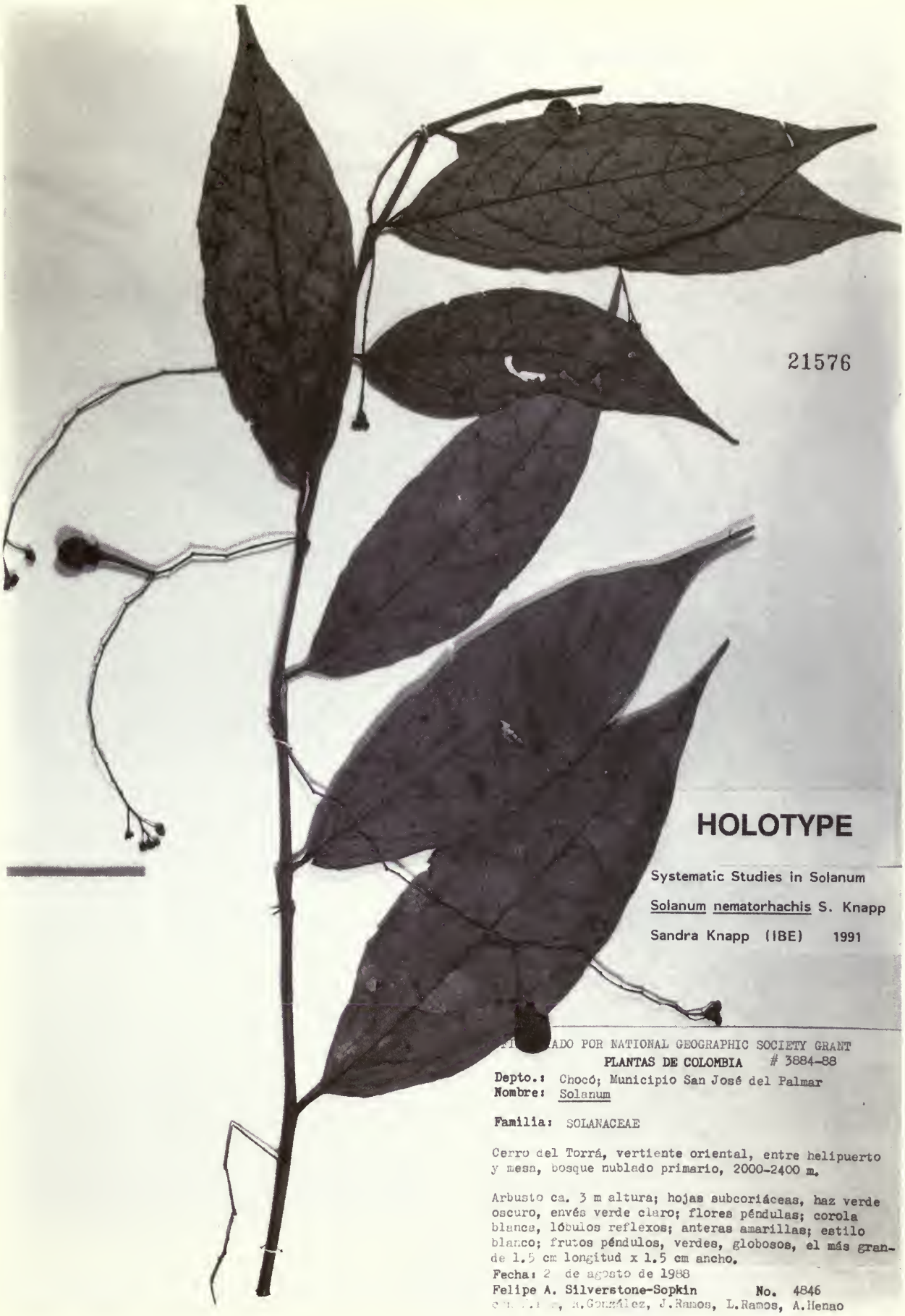

21576
HOLOTYPE
Systematic Studies in Solanum
Solanum nematorhachis S. Knapp
Sandra Knapp (IBE) 1991
ADO POR NATIONAL GEOGRAPHIC SOCIETY GRANT
PLANTAS DE COLOMBIA # 3884-88
Depto.: Chocó; Municipio San José del Palmar
Nombre: Solanum
Familia: SOLANACEAE
Cerro del Torrá, vertiente oriental, entre helipuerto y mesa, bosque nublado primario, 2000-2400 m.
Arbusto ca. 3 m altura; hojas subcoriáceas, haz verde oscuro, envés verde claro; flores péndulas; corola blanca, lóbulos reflexos; anteras amarillas; estilo blanco; frutos péndulos, verdes, globosos, el más grande 1.5 cm longitud x 1.5 cm ancho.
Fecha: 2 de agosto de 1988
Felipe A. Silverstone-Sopkin No. 4846
R.González, J.Ramos, L.Ramos, A.Henao

Fig. 3 Holotype of *Solanum nematorhachis* S. Knapp (*Silverstone-Sopkin et al. 4846*, CUVC); (b) isotype of *Solanum nematorhachis* S. Knapp (NY)

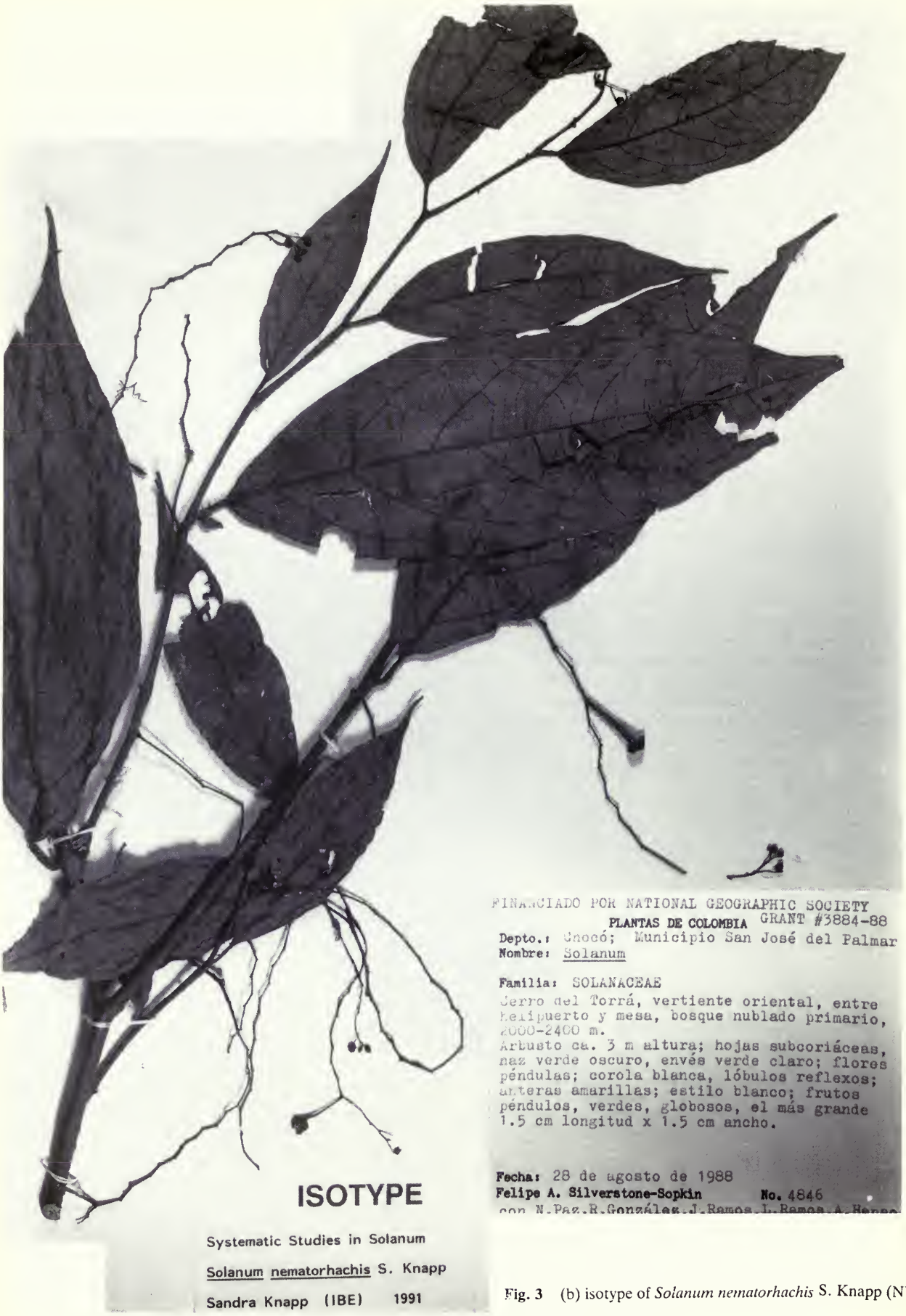

FINANCIADO POR NATIONAL GEOGRAPHIC SOCIETY
PLANTAS DE COLOMBIA GRANT #3884-88
Depto.: Chocó; Municipio San José del Palmar
Nombre: Solanum
Familia: SOLANACEAE
Cerro del Torrá, vertiente oriental, entre Peñipuerto y mesa, bosque nublado primario, 2000-2400 m.
Arbusto ca. 3 m altura; hojas subcoriáceas, haz verde oscuro, envés verde claro; flores péndulas; corola blanca, lóbulos reflexos; anteras amarillas; estilo blanco; frutos péndulos, verdes, globosos, el más grande 1.5 cm longitud x 1.5 cm ancho.
Fecha: 28 de agosto de 1988
Felipe A. Silverstone-Sopkin No. 4846
ISOTYPE
Systematic Studies in Solanum
Solanum nematorhachis S. Knapp
Sandra Knapp (IBE) 1991

Fig. 3 (b) isotype of *Solanum nematorhachis* S. Knapp (NY)

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 153–156 Issued 26 November 1992

Fissidens ceylonensis Dozy & Molkenb. (Musci: Fissidentaceae) and some allied taxa from southern India

L.T. ELLIS

Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD

SYNOPSIS. *Fissidens ceylonensis* Dozy & Molkenb. is described and compared with some related taxa. *F. ceylonensis* var. *acutifolius* Dixon & P. Varde is considered to be a distinct taxon possibly warranting the rank of species, whereas *F. pennatulus* Thwaites & Mitten and *F. perpusillus* Wilson ex Mitten are regarded as forms of *F. ceylonensis*. The taxonomic status of *F. karwarensis* Dixon remains uncertain, its resolution will require the examination of a wider range of specimens.

The late A.H. Norkett, an acknowledged authority on the moss genus *Fissidens*, undertook two expeditions to India (1966–1967, 1970–1971) during his career at the Natural History Museum (BM). Material of *Fissidens ceylonensis* Dozy & Molkenb. and closely related taxa, which he collected in southern India on the first of these expeditions, has formed the basis for a preliminary investigation into the interrelationships of these plants.

Fissidens ceylonensis Dozy & Molkenb., *Annls Sci. nat.* Bot. sér. 3, **2**: 304 (1844). Type: Sri Lanka [Ceylon], [*Koenig] s.n.* (BM!, NY!—isotypes).

Fissidens bicolor Thwaites & Mitten, *J. Linn. Soc. Bot.* **13**: 322 (1873). Type: Sri Lanka [Ceylon], *G. Thwaites [137b* in Hb. Dixon] (BM!—isotype).

Fissidens perpusillus Wils. *ex* Mitten, *J. Linn. Soc. Bot.* Suppl. 1: 141 (1859). Type: Sri Lanka [Ceylon], *Gardner 630* (NY!—holotype; BM!—isotype).

Fissidens thwaitesii Par., *Index Bryol.* 488 (1896). [*F. papillosus* Thwaites & Mitt., *J. Linn. Soc. Bot.* **13**: 323 (1873), *hom. illeg.*] Type: Sri Lanka [Ceylon], *G. Thwaites [137* in Hb. Dixon] BM!—isotype).

Fissidens pennatulus Thwaites & Mitten, *J. Linn. Soc. Bot.* **13**: 325 (1873). Type: Sri Lanka [Ceylon], *G. Thwaites [136]* (NY!—holotype; BM!— isotype).

Plants forming pale yellowish-green to dark green, sparse to dense patches; shoots 2–6 (– 9) mm long, straight to curved, sometimes branched; stems in cross section elliptical, central strand barely perceptible, cells of cortex small and thick walled, 1–2 layers (those of the outer layer often protruding slightly from the stem surface). Leaves in about 6–18 (– 30) pairs, often slightly overlapping, straight when moist, hardly altered to curving ventrally when dry, mostly 0.8–1.2 × (0.15 –) 0.2–0.25 (– 0.3) mm, oblong-lanceolate with mucronate apices (Fig. 1a). Costa usually excurrent, occasionally percurrent. Vaginant lamina about 3/5–4/5 of leaf length, unequal at apex (point of apex usually lying near to leaf margin), margins of vaginant lamina often limbate from base to apex or to near apex; limbidium sometimes poorly developed, or lacking (especially in lower leaves of the shoot), marginal for most of its length, composed of linear to sublinear cells, the outermost row frequently give rise to small, distant teeth; most leaves with a single row of small, quadrate to shortly rectangular (sometimes papillose) cells forming part of the margin along the mid to basal vaginant lamina and giving the limbidium an intramarginal appearance (Fig. 1k). Dorsal lamina narrowing gradually from above mid-leaf, usually tapering into costa at, or slightly above, the leaf base (sometimes curving abruptly into the base of the costa). Margins of dorsal and apical laminae papillose-crenulate. Laminal cells mostly isodiametric with 4–6 sides, 5–10 (– 12.5) × 5–10 μm, multi-papillose, in the leaf base becoming shortly subrectangular and smoother. Autoecious (Dioecious in '*perpusillus*' form): perichaetia terminal; male branches axillary on female shoots, normally diminutive with underdeveloped leaves or bud-like (Fig. 2a, b) , sometimes larger with leaves well developed (in '*perpusillus*' form apparently independent of female shoots)(Fig. 2c, d), perigonia terminal. Seta 2–3 mm long, yellow to red; capsule erect to inclined, theca shortly cylindrical to ellipsoidal, symmetrical, 0.4–0.6 mm long, walls of epithecial cells thickened at angles; operculum with subulate beak. Spores spherical, 15–17.5 mm diam., finely papillose.

ECOLOGY AND DISTRIBUTION. *Fissidens ceylonensis* Dozy & Molk. occurs on sandy and clay soils, and has been collected on bare ground, soil overlying rocks, amongst the roots of trees and on the banks of streams. Shaded situations are favoured. *F. ceylonensis* (*sensu lato*) is well represented in southern India and Sri Lanka and the type variety, at least, appears to be generally distributed throughout tropical Asia.

DISCUSSION. Fleischer (1904) and Norris and Koponen (1987) place *Fissidens perpusillus* in synonymy with *F. ceylonensis*, while Eddy (1988) retains it as a distinct species. The majority of specimens from the study area are easily recognisable as one or the other, but there are a significant number which possess ambiguous features and are difficult to place. A key difference used to differentiate the two taxa is that most leaves in specimens of *F. ceylonensis* possess vaginant laminae with limbidia; whereas in specimens of *F. perpusillus* similar limbidia occur only in the perichaetial and subperichaetial leaves. Specimens with limbidia distributed as in *F. ceylonensis* often possess excurrent costae and dorsal laminae

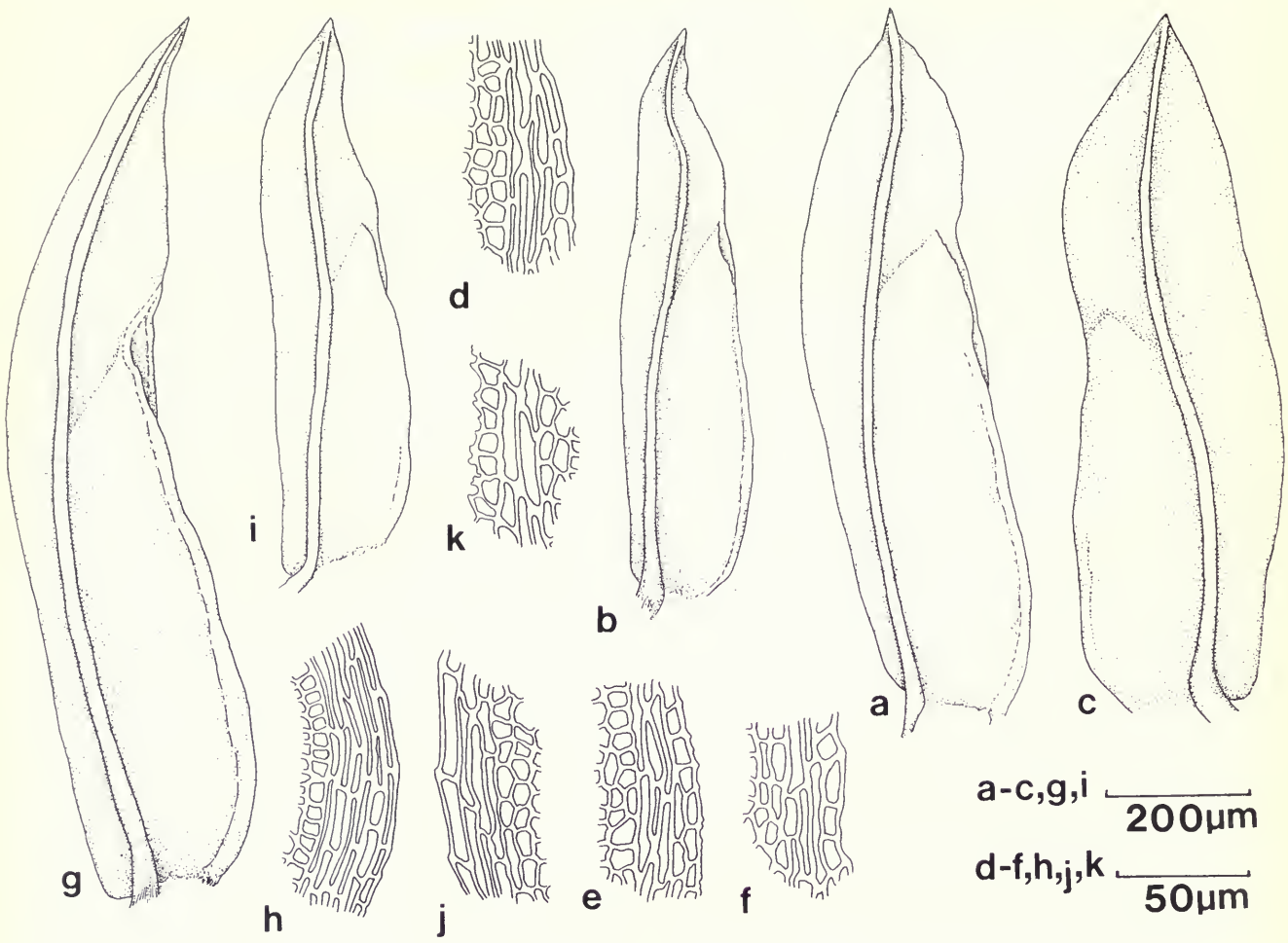


Fig. 1 *Fissidens ceylonensis* Dozy & Molkenb. a-c: leaves; d-f: limbidium in vaginant lamina (d: near apex, e,f: near base. *Fissidens ceylonensis* var. *acutifolius Dixon & P. Varde. g: leaf; h:* limbidium near base of vaginant lamina. *Fissidens karwarensis* Dixon. i: leaf from mid-shoot; j, k: limbidium near base of vaginant lamina (j: as frequently occurring, k: as very rarely occurring). a, d, e, Drawn from Sri Lanka, *Alston 1769* (BM); b, from Sri Lanka. *Thwaites 136* (type of *F. pennatulus*) (BM); g, h, from southern India, *Foreau 216* (BM); i-k, from southern India, *Sedgwick 6368* (lectotype of *F. karwarensis*) (BM).

which gradually taper into the base of the costa. Many specimens in which the limbidia occur as in *F. perpusillus*, (the '*perpusillus*' form), possess leaves with percurrent costae and dorsal laminae which curve abruptly into the base of the costa. However, all of these features can be rather variable and do not always occur together. In most material from the study area, identified as *F. ceylonensis* or *F. perpusillus*, the form of the male shoots is correlated to some extent with the distribution of limbidia. Plants exhibiting the features associated with *F. perpusillus* tend to produce perigonia at the apex of small leafy shoots (occasionally comparable in size to female shoots); their attachment to the female shoots is difficult to establish. In specimens apparently referable to *F. ceylonensis* the perigonia occur as, or on, diminutive axillary branches. These are unequivocally attached to the female shoots and rarely produce fully developed leaves. Unfortunately, some specimens do not show this apparent correlation of features—for example, southern Indian specimens otherwise resembling *F. perpusillus*, such as *Norkett 11369* (BM), which has large, leafy shoots with terminal (rarely lateral) groups of bud-like perigonia and solitary archegonia sparsely scattered on the upper stem (Fig. 2e).

SELECTION OF HERBARIUM SPECIMENS EXAMINED.

F.CEYLONENSIS (TYPICAL FORM). **Southern India**. Kerala State: Kerala, near Kellar, 1967, *A.H. Norkett 12645* (BM!); 12 miles from Trivandrum, 1967, *A.H. Norkett 12650* (BM!). Tamil Nadu, Courtallam, 1967, *A.H. Norkett 13133* (BM!). **Sri Lanka**. Morowak Korale, Campein Hill Estate, 1890, *A. Waddell s.n.* (BM!); 1928, *A. Alston 1769* (BM!); Heneratgoda Gardens, *A. Alston 1983*. **Malay Peninsula**, Singapore, 1898, *M. Fleischer exs. no. 74* (NY!). F. CEYLONENSIS ('PERPUSILLUS FORM'). **Southern India**, Tamil Nadu, Courtallam: 1966, *A. H. Norkett 11340/11338* (BM!); near Old Falls, 4 miles south of Courtallam, 1966, *A.H. Norkett 11369* (BM!); above Tourist Bungalow, 1967, *A.H. Norkett 13105* (BM!); jungle area, 1967, *A.H. Norkett 13118* (BM!); Nilgiri Mountains, *Beddome 707* (NY!). **Sri Lanka**. Uva Province, Badulla District, between Ella and Wellawaya, south of Ravanala Falls, 1973, *C.C. Townsend 1125, 1126* (BM!).

Fissidens ceylonensis var. **acutifolius** Dix. & P. Varde, *Rev. bryol.* **52**: 38 (1925). Type. Southern India, Shembaganur, 1912, *G. Foreau 235 ['1824' in Hb. Dixon*] (BM!—isotype?)

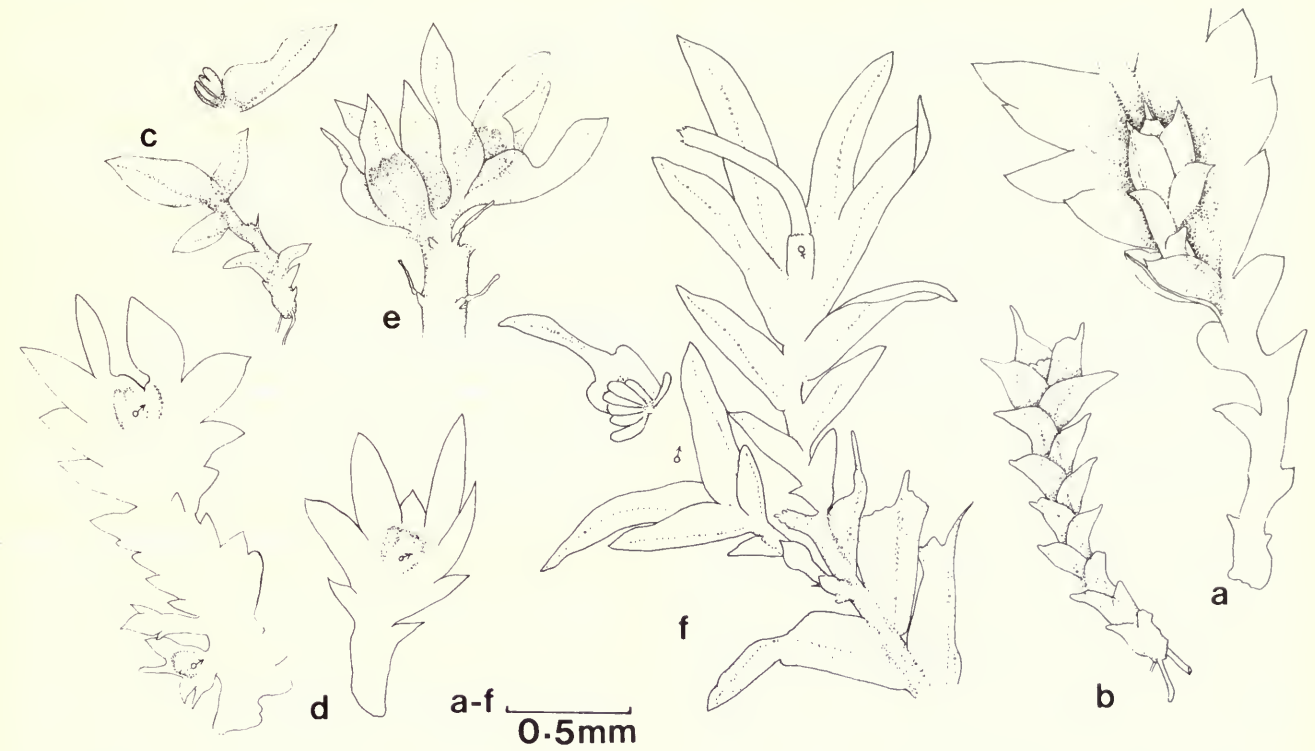


Fig. 2 *Fissidens ceylonensis* Dozy & Molkenb. (typical form) a: outline of a female shoot bearing axillary male branch; b: a detached axillary male branch. *Fissidens ceylonensis* (*'perpusillus'* form). c-e: shoots bearing gametangia (c: independent leafy male shoot (with groups of antheridia and perigonial leaf shown detached): outlines of male shoots showing positions of perigonia; e: apical region of shoot (leaves removed) showing terminal perigonia and scattered, solitary archegonia). *Fissidens karwarensis* Dixon. f: part of old, degenerating shoot supporting new leafy male and female shoots (male shoot with group of antheridia and inner-perigonial leaf shown detached). a, Drawn from Sri Lanka, *Alston 1769* (BM); b, from Sri Lanka, *Thwaites 137b* (BM) (type of *F. bicolor*); c, from Sri Lanka, *Gardner 630* (type of *F. perpusillus*) (BM); d, from southern India, *Norkett 11328* p.p. (BM); e, from southern India *Norkett 11369*; f, from southern India *Sedgwick 6368* (type of *F. karwarensis*) (BM).

Eddy (1988) found *Fissidens pennatulus* to be conspecific with *Fissidens ceylonensis*. In the type specimens of these taxa the limbidium in at least some vaginant laminae appears to be intramarginal for a short part of its length where a row of subquadrate cells form the leaf margin (Fig. 1f). The majority of specimens from southern India (in NY and BM) originally identified as *F. pennatulus* possess a broad limbidium which usually extends the full length of the vaginant lamina and completely lacks a margin of subquadrate cells (Fig. 1h). In this and other features these specimens closely resemble type and authentic material of *F. ceylonensis* var. *acutifolius* Dixon & P. Varde. Several specimens referable to *F. ceylonensis* var. *acutifolius* possess slender leaves with acute apices (Fig. 1g). However, it is the structure of the limbidium, and not the form of the leaf, which is the distinctive and consistent feature. The type (*Foreau [235] '1824'*, BM) is unusual in including female shoots with small, bud-like, axillary male branches as well as apparently independent, leafy male shoots with terminal perigonia.

Foreau [235] '1824', along with authentic material (det. P. Varde) from the type locality (NY) and the other specimens listed below appear to form a discrete group, and thus provide justification for retaining *F. ceylonensis* var. *acutifolius* as a distinct taxon. (It may even warrant the rank of species.)

Four collections from Burma, identified as *Fissidens ceylonensis* (*Möller s.n.* NY!, BM!), include shoots in which the limbidia are arranged on the leaves as in those found in 'var. *acutifolius*'. Some of the sporophytes in this material are terminal on well-developed shoots (as would be expected in *F. ceylonensis*), while others appear to emerge from the axils of basal leaves, or, at least, are terminal on very short axillary branches. The setae attain more than twice the length commonly observed in southern Indian collections of *F. ceylonensis*. These Burmese collections can not yet be comfortably grouped with *Fissidens ceylonensis* var. *acutifolius* or the type variety.

SELECTION OF HERBARIUM SPECIMENS EXAMINED. F. CEYLONENSIS VAR. ACUTIFOLIUS. **Southern India**, Tamil Nadu, Palni Hills: Kodai-Kanal, 1913 *F. Marler 35* (BM!); Perumalmali Shola, 1925, *G. Foreau 216* (BM!, NY!); Shembaganur, *G. Foreau 110*, *368*, *614*, *1312*, *s.n.*(NY!); Travancore, Kumili, *G. Foreau 589* (NY!). Tamil Nadu, Nilgiri Hills: *Beddome 499*, *547* (NY!); Kotagiri Road, 1966, *A.H. Norkett 11411* (BM!). Tamil Nadu/Kerala border, Mangoli, High Wavy Mountains, 1967, *A.H. Norkett 13269* (BM!). **Sri Lanka**. Nuwara Eliya, 1913, *C.H. Binstead 252* (BM!); Udapassellawa, 1913, *C.H. Binstead 402* (BM!).

Fissidens kawarensis Dixon', *J. Indian Bot.* **2**: 179 (1921). Type: Southern India, Karwar, October 1919, *L.J. Sedgwick 6368* (BM!—lectotype proposed here).

This species resembles the '*perpusillus*' form of *Fissidens ceylonensis* except that the leaves and the sporophytes attain relatively larger dimensions. In the type specimen, the longest leaves reach 1.5–1.8 × 0.2– 0.4 mm. Limbidia are best developed in the upper leaves of fertile shoots (Fig. 1j,k). They are often obscure in leaves lower on the stem and obscure or absent in the leaves of sterile shoots. The dorsal lamina usually curves abruptly into the base of the costa, but in some leaves (especially those toward the apex of the shoot) it tapers gradually into the leaf base. Laminal cells show a similar range of size to those of *F. ceylonensis*, >5–12.5 × >5–12.5 μm. Autoecious (and possibly dioecious), the male and female branches may originate from different leaf-axils on the same degenerating shoot of the previous generation and are similar in size and proportions (Fig. 2f). Perichaetia and perigonia are terminal. Sporophytes are similar to those in *F. ceylonensis* except that the seta reaches 3–5 mm in length and the longest theca examined is 0.75 mm.

The lectotype, *Sedgwick 6368* was collected on stones and a paratype, *Sedgwick 3485* (Shiggaon, Dharwar District) (BM!) from the bole of a coconut palm.

On the available evidence it would be unsafe to consider *Fissidens karwarensis* to be conspecific with *F. ceylonensis*.

ACKNOWLEDGEMENTS. I am grateful to Dr A.J. Harrington for his valuable comments on the manuscript and also thank the Directors and staff at New York (NY) and Helsinki (H) for the loan of specimens.

REFERENCES

Eddy, A. 1988. *A Handbook of Malesian Mosses.* **1.** *Sphagnales to Dicranales.* London.

Fleischer, M. 1904. *Die Musci der Flora von Buitenzorg* **1.** Leiden.

Norris, D. & Koponen, T. 1987. Bryophyte flora of the Huon Peninsula, Papua New Guinea XX. Fissidentaceae, Mitteniaceae, Phyllodrepaniaceae, Phyllogoniaceae and Sorapillaceae :(Musci). *Ann. bot. fenn.* **24**: 177–219.

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 157–158 Issued 26 November 1992

New species of *Piper* (Piperaceae) from Central America

MARGARET TEBBS

c/o Royal Botanic Gardens, Kew, London

SYNOPSIS. During the preparation of the genus *Piper* (Piperaceae) for Flora Mesoamericana, two new species were discovered, both from Panama. The first, *Piper canaliculum*, is a fleshy-stemmed shrub with large, obovate leaves and stout inflorescences, collected from the provinces of Coclé, Panama, and San Blas. The second, *P. premnospicum*, is a low shrub or subshrub, with yellowish-pubescent stems and short, subglobose inflorescences, collected only from the province of Coclé.

Piper canaliculum Tebbs **sp. nov.**
(Fig. 1a,b,c)

Caules carnosus, canaliculatus. Folia obovata, glandulosa, pili petioli vaginans.

Holotype: Panama, Cerro Obu, Comarca de San Blas, 400–500 m, *Nevers, Herrera & Gernada 8079*, (BM!); isotype (MO!). *Shrub* 1–2.5 m; stems fleshy, longitudinally deeply grooved, minutely puberulent with white or yellow hairs. *Leaves* 24–32 × 10–14 cm, obovate, upper surface covered with white hairs 0.2–0.5 mm long, underside paler, with black or brown glands, minutely white puberulent especially along the veins; apex obtuse; base narrowly shallowly lobed. *Venation* with 4–6 prominent secondary veins arising from the lower to middle part of the midrib, curving steeply to the apex. *Petioles* 10–40 mm, puberulent, sheathing the stem. *Inflorescences* 4–7 cm long, stout, erect; peduncles 10–15 mm long, minutely puberulent. *Anthers* 0.2–0.3 mm. *Floral bracts* 1–1.5 mm wide, triangular, minutely pale-ciliate, with dark centre. *Fruits* 1–2 mm, round to trigonous from above, glandular, glabrous; stigmas 3.

DISTRIBUTION: **Panama**, tropical wet forest, low cloud forest; 300–1200 m.

REPRESENTATIVE SPECIMENS: Coclé, *Sytsma & Andersson 4545* (BM!, MO!); Panamá, *Dressler 3763*; San Blas, *Nevers 4042* (MO!); *Nevers & Herrera 6658* (MO!); *Sytsma, Antonio & Dressler 2747* (BM!, MO!).

The thick, fleshy stems with deep, ridge-like grooves, and the large, obovate leaves with narrow basal lobes distinguish this species. It has only been collected from three areas of Panama. *Piper canaliculum* is in Section *Peltobryon* Klotsch ex Miquel, which contains a group of species with densely glandular leaves, the glands yellow, orange, brown or black, and fleshy, often glandular fruits with minute to elongated styles.

Piper premnospicum Tebbs **sp. nov.**
(Fig. 1d,e)

Folia obovata, supra scabrosa, subter pili densi. Spica erecta, 1.2–2 cm, subglobosa; bacca 1–2 mm, stylus 2–3 mm, rectus, elongatus, stigmata 2. Holotype: Panama, El Valle Mesa, Coclé, 800 m, *Folsom, Hartman & Butcher 4646* (MO!). *Low shrub* or subshrub 0.3–1 (–2) m; stems densely crisp-pubescent with yellowish hairs. *Leaves* 10–18 × 6–10 cm, obovate to elliptic-obovate, upper surface dark green, scabrous, underside paler, densely hirsute, especially on veins; apex acute to obtuse; base unequally obtuse to rounded. *Venation* with 4–5 pairs of secondary veins arising from the lower to middle part of the midrib, curving steeply to the apex. *Petioles* 12–25 mm, densely pubescent. *Prophylls* 10–20 mm, pale-pubescent, drying to dark brown or black. *Inflorescences* 1.2–2 cm long, erect, subglobose, narrowing to crisp-pubescent tips 1–5 mm long; peduncles 4–12 mm, densely pubescent. *Anthers* 0.8–1 mm. *Floral bracts* 1–2 mm, triangular, mostly glabrous, with pale hairs at the base. *Fruits* 1–2 mm, round to trigonous from above, glabrous, with straight, prominent styles 2–3 mm long; stigmas 2, recurved.

DISTRIBUTION: **Panama**, disturbed areas, dense rain forest, premontane or montane forest, mature forest understory and cloud forest; 400–1000 m.

REPRESENTATIVE SPECIMENS: Coclé, *Croat 14279* (MO!); *Dwyer 8921* (MO!); *Knapp & Dressler 3428* (MO!), *4916* (BM!, MO!); *Lewis et al 1784* (MO!); *Sytsma et al. 4385* (MO!).

Piper premnospicum has only been collected from the province of Coclé, Panama. It is closely related to *P. cuspidispicum* Trel., with similar inflorescences, and long, straight styles with two recurved stigmas. However, *Piper cuspidispicum* is a glabrous shrub up to 3 m in height, with glossy, ovate to ovate-elliptic leaves, and glabrous prophylls. *Piper premnospicum* is in Section *Isophyllon* Miquel, the species of which are distinguished by their short inflorescences, with distinct sterile tips.

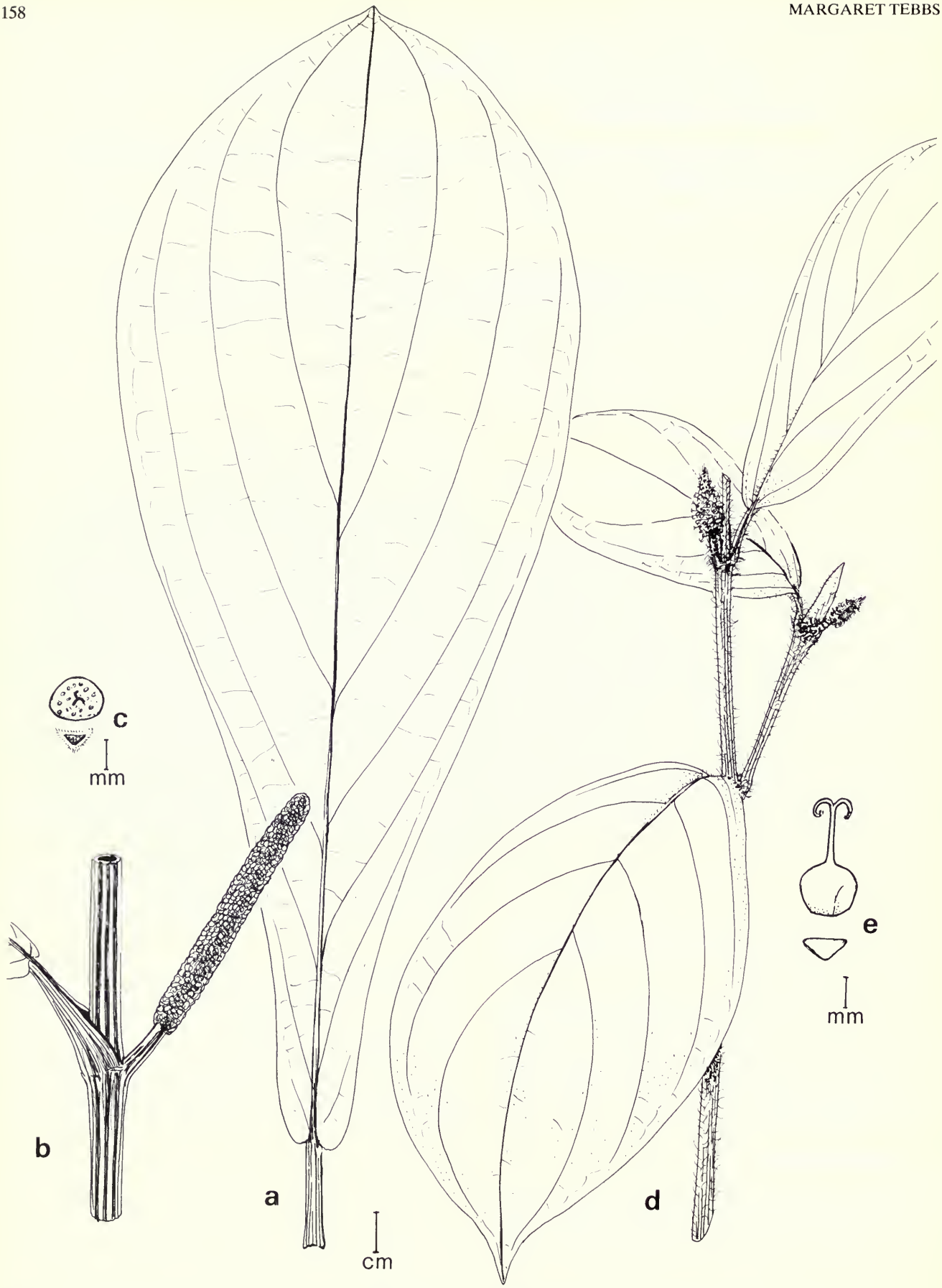


Fig. 1 *Piper canaliculum*, a: leaf; b: inflorescence; c: fruit and bract. *P. premnospicum*, d: stem; e: fruit and bract.

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 159–164 Issued 26 November 1992

Studies on the Cretan flora 1. Floristic notes

NICHOLAS J. TURLAND

Ludlow House, 12 Kingsley Avenue, Kettering, Northamptonshire NN16 9EU

Synopsis. Distributional, ecological and historical notes are provided for flowering plants occurring in the Cretan area (the islands of Crete, Kasos, Karpathos and Saria) in the South Aegean region. Uncommon, localized and endemic taxa are covered, including four new records from Crete: *Arum cyrenaicum* Hruby (also new for Europe), *Kochia scoparia* (L.) Schrader, *Phlomis* x *cytherea* Rech.fil., and *Taraxacum hellenicum* Dahlst. The occurrence of *Abutilon theophrasti* Medicus, *Carex illegitima* Cesati, *Colchicum cupanii* Guss., *Cymbalaria microcalyx* subsp. *dodekanesi* Greuter, and *Gagea fibrosa* (Desf.) Schultes & Schultes fil. in Crete is confirmed. *Atractylis gummifera* is recorded for the first time from Karpathos.

INTRODUCTION

The Cretan area, in the south Aegean region, is the most south-easterly floristic territory defined in *Flora Europaea*. The area includes not only the main island of Crete but the island group of Kasos, Karpathos and Saria to the north-east. All belong to the central part of a partially submerged arc of mountains which once linked the Greek Peloponnisos with the Taurus mountains of southern Turkey. Elements within the flora reveal these former links with Europe and Asia Minor. Occurring together with widespread Euro-Siberian and Mediterranean plants are taxa which otherwise exist only in Greece and the Balkan peninsula, or in south-western Asia. Two examples of Asiatic plants with their only European stations in the Cretan area are *Datisca cannabina* (*Datiscaceae*) and *Lecokia cretica* (*Umbelliferae*).

The islands of the Cretan area have remained separate from the continents for several million years and, not surprisingly, there is a high level of endemism in the flora, with roughly ten per-cent of the *c.* 1700 native species of vascular plants occurring nowhere else. Many of these are vicariously represented by relatives in other parts of the Aegean region and adjacent areas, although a few are without close affinities, e.g. *Petromarula pinnata* (*Campanulaceae*).

A full historical account of botanical exploration of the area will not be given here, although a brief outline of some of the more recent and important floristic studies seems appropriate. Karl Heinz Rechinger (Vienna) collected extensively in the Aegean region during the 1930s and his *Flora Aegaea* (Rechinger, 1943a) covers the Cretan flora on the basis of earlier botanists' work. He visited Crete himself in 1942 and published a full account of his itinerary and collections, as well as descriptions of new taxa (Rechinger, 1943b).

Subsequent floristic studies are widely dispersed in botanical literature and include numerous papers by Werner Greuter (Berlin, formerly Geneva), who intensively explored Crete during the 1960s. Among them is a paper correcting the first two volumes of *Flora Europaea* (as far as the Cretan area is concerned) and providing lists of species doubtfully or erroneously recorded (Greuter, 1974). There are also four papers detailing floristic additions since *Flora Aegaea* (Greuter, 1973; Greuter, Matthäs & Risse, 1984a, b, 1985). The most up-to-date and comprehensive work on the Cretan flora (excluding the Karpathos island group) is the checklist compiled by Sir Colville Barclay (1986). The only recent and comprehensive work on the Karpathos island group is the basic checklist by Greuter, Pleger and Raus (1983).

Botanical activity in the Cretan area during the years since 1986 has been considerable. A publication by Jacques Zaffran (University of Provence) gives details of his collections together with phytosociological studies (Zaffran, 1990). The author's own field-work in Crete began in 1984, much of it jointly carried out with Mr Lance Chilton, who first visited the island in 1982 and resided there for the greater part of five years from 1987. Their initial floristic findings have been compiled by Turland (1992).

The quantity and importance of data which have accumulated since 1986 led to the initiation of the project to compile an up-dated and annotated checklist of the Cretan flora. This will be published in a single volume as a product of the Natural History Museum's European Plant Information Centre. The scope of the new checklist will include the Karpathos island group, thereby making it directly comparable with the treatment of the Cretan area provided in *Flora Europaea*. Annotations will include habitats, altitudinal ranges and flowering times, where known, as well as distributions within and outside the area. A distribution map will be provided for each species, prepared by Chilton, based on his own field observations and those of the author, as well as records from literature sources.

In order that the concise presentation planned for the checklist may be maintained, various significant new data are presented here as floristic notes. The plant records are mostly made by Chilton and the author; those by others are included only when they could be confirmed. The sequence of taxa follows that of the checklist, i.e. alphabetical, by families, genera, and species. Localities are headed by their eparchy (administrative district) or nomos (prefecture). Where more than one locality is cited, the order runs from west to east. The transliteration of Greek place-names follows Greuter (1973) and Greuter, Matthäs & Risse (1984a, b, 1985), with the following exceptions: the Greek letter gamma always becomes 'g', never 'j', and delta becomes 'd', not 'dh'. This is the system currently used on Greek road-signs bearing Roman spelling as well as Greek.

FLORISTIC NOTES

DICOTYLEDONES

CHENOPODIACEAE

Kochia scoparia (L.) Schrader (new record)

Kidonia: Maleme 15 km W of Hania, 10 m, roadside, 1991, *Chilton* obs.; Hania town, 10 m, roadside, 1990, *Chilton* obs. **Apokoronos**: Georgioupoli, 10 m, trackside, 1990, *Chilton* obs. **Agios Vasilios**: Plakias, sea-level, stream-gravel, 1990, *Chilton* obs. **Rethimni**: Venetian fortress in Rethimno town, 20 m, paths and waste ground, 1990, *Chilton* obs.; Misiria just E of Rethimno, 5 m, waste ground at back of beach, 1990, *Chilton* obs. **Pirgiotissi**: Matala, 10 m, waste ground and roadside, 1991, *Chilton* obs.; Agios Ioannis 5.5 km SE of Timbaki, 30 m, roadside, 1990, *Chilton* obs. **Malevizi/Temenos**: Ammoudara just W of Iraklio, 5 m, roadside, 1990, *Chilton* obs. **Temenos**: Venerato 18 km SSW of Iraklio, 250 m, roadside, 1990, *Chilton* obs. **Pedias**: Kokkini Hani 10 km E of Iraklio, 5 m, waste ground, 1990, *Chilton* obs. **Lasithi**: Tzermiado, 850 m, waste ground, 1990, *Chilton* obs. **Mirambello**: Sissi 9 km NW of Neapoli, 15 m, waste ground, 1990, *Chilton* obs.

This species is cultivated for ornament and is recorded in *Flora Europaea* as naturalized in central, eastern and southern Europe, but not in Crete (Ball, 1964a: 99). The records cited here appear to be the first correct ones from Crete and Chilton's observations suggest that the species is becoming naturalized in at least some of the localities. *Kochia scoparia* is cultivated in Crete, but none of the plants observed was growing near such material, although some were near gardens. An old Cretan record by Gandoger was rejected as erroneous by Greuter (1974: 155).

Noaea mucronata (Forskål) Ascherson & Schweinf.

Kidonia: Akrotiri, in saxosis maritimis, 10.1899, *Mancuso* in herb. Baldacci (BM!). This collection from the Akrotiri peninsula in north-western Crete appears to have been overlooked, as the Cretan area is omitted from the range given in *Flora Europaea* (Ball, 1964b). In the apparent absence of any more recent collections, it is best to consider the species as doubtfully present in Crete until confirmation becomes available. The species occurs in the wider Cretan area, however, having been recorded from Kasos, in the Karpathos island group, by Greuter (1974: 146). A distribution map is given by Jalas and Suominen (1980: 84, map 607).

COMPOSITAE

Atractylis gummifera L.

Karpathos: 9.1988, *Barclay* obs. The occurrence of this Mediterranean species in Crete is well documented but it has not been recorded previously in the Karpathos island group.

Taraxacum Wiggers

Flora Europaea cites *Taraxacum megalorhizon* (Forskål) Hand.-Mazz. and the *T. officinale* group from the Cretan area (Richards & Sell, 1976: 334, 341). The presence of the latter is rejected by Greuter, Matthäs & Risse (1984b: 274), who state 'The old record by Heldreich quoted by Rechinger (1943a: 692) has never been disclaimed, although it obviously refers to the very broad aggregate comprising the whole genus.' They accept, however, the presence of *Taraxacum* sect. *Scariosa* Hand.-Mazz. emend. Dahlst., to which *T. megalorhizon* belongs. According to Richards (pers. comm., 1988), *T. megalorhizon* is best treated as a nomen confusum. The following taxa in sect. *Scariosa* are known to occur in Crete. They tend to be small plants of rock-crevices and bare soil, often in the mountains, flowering in autumn (sometimes before the leaves develop) and in spring.

Taraxacum aleppicum Dahlst.

This species occurs also in Greece and south-western Asia and is recorded from Crete by van Soest (1975: 799). Richards (1991: 547) gives it as occurring on the Omalos plain, in the Samaria gorge and the Dikti massif.

Taraxacum bithynicum DC.

Sfakia: above SE edge of Omalos plain, path from Xiloskala pass to Kallergi mountain refuge, 1200 m, under *Zelkova abelicea* (Lam.) Boiss., 3.8.1989, *A.J.Richards* (herb. A.J.Richards). *Taraxacum bithynicum* DC. is a mostly Turkish alpine species, which has its only European stations in Crete. It is recorded from the island by Rechinger (1943b: 159) and by van Soest (1975: 799), according to whom it possibly does not belong within sect. *Scariosa* at all.

Taraxacum hellenicum Dahlst. (new record)

Agios Vasilios: hill 0.5 km E of Aktounda (S of Spili), 600 m, open phrygana over serpentine, with *Taraxacum minimum*, 30.3.1991, *Turland* 409 (BM, herb. A.J.Richards)—det. A.J.Richards (Newcastle-Upon-Tyne). **Sitia**: immediately W of Toplou monastery, 200 m, roadside, one large clump growing with *T. minimum*, 6.4.1990, *A.J.Richards* (herb. A.J.Richards).

According to Richards (pers. comm. 1990, 1991), these are the first Cretan records of this Mediterranean species. He strongly suspects that the single plant at Toplou is an adventive from the Greek mainland, where the species also occurs. It seems reasonable to assume, however, that the population at Aktounda is native. The locality is not near any ports or in an area subjected to heavy tourism, and the habitat is undisturbed, so it is unlikely that an introduced *Taraxacum* would become established there.

Taraxacum minimum (Briganti ex Guss.) N.Terracc.

According to Richards (pers. comm., 1988–1991), and from the author's own collections and observations to date, it appears that this is the commonest segregate taxon in sect. *Scariosa* in Crete. It occurs throughout much of the island, as well as more widely in southern Europe and south-western Asia.

CONVOLVULACEAE

Ipomoea imperati (Vahl) Griseb.

(*I. stolonifera* (Cyr.) J.F.Gmelin)

Kissamos: coast at Drapanias 4.5 km E of Kastelli Kissamou, near sea-level, sand dunes, 10.1987, *C.C.Wilson* colour photo! (herb. Turland); same locality, 10.1991, *C.C.Wilson* seed collection! (hort. Turland).

This largely tropical and warm-temperate species was first recorded in Crete by Rechinger, on the island of Elafonisi in the south-west, as '*Calystegia soldanella*' (Rechinger, 1943b: 107). He later corrected this mis-identification and cited a second collection by Barneby & Davis from Malia on the northern coast, east of Iraklio (Rechinger, 1949: 205). Greuter (1973: 48, 49) confirms the identity of the Elafonisi collection as *Ipomoea* but suggests that the Malia record is probably referable to *Calystegia soldanella* (L.) R.Br., which he cites from a point approximately 25 km west along the same stretch of coast. *C. soldanella* is fairly widespread in Crete, also occurring on the Akrotiri peninsula in the north-west (Greuter, op. cit.: 49) and in the same areas where *Ipomoea* occurs: on Elafonisi island (27.4.1989, *Turland* obs.) and on the coast immediately east of Kastelli Kissamou (9.8.1991, *Turland* 546 (BM)). In the vegetative state, *I. imperati* may be distiguished by the shape of its leaves, which are oblong or slightly three-lobed, unlike those of *C. soldanella*, which are reniform. Until confirmation is available, it seems best to accept Greuter's opinion that the Malia population is probably *Calystegia* and not *Ipomoea*, which is known with certainty only from the extreme western part of Crete.

In Europe *Ipomoea imperati* has only a few populations outside Crete: in the Azores, on Cabrera island south of Mallorca (Bonafè Barceló, 1979: 346), and in southern Italy. These lie on the northern limit of its extensive world distribution, which includes the Americas as well as the Old World. Another Greek occurrence was reported by Goulimis (1956), from the east Aegean island of Rodos, outside the European floristic area. Goulimis cited the record again in Goulandris et al. (1968: 88), where he stated that the species also occurs on the Greek island of Elafonisi, between the eastern peninsula of the southern Peloponnisos and the island of Kithira. This is erroneous, however, owing to confusion with the Cretan island of the same name (Yannitsaros, 1971: 149). The illustration given by Goulandris et al. (op. cit.: 89) shows the distinctive, oblong leaf-shape referred to above.

DIPSACACEAE

Lomelosia albocincta (Greuter) Greuter & Burdet

(*Scabiosa albocincta* Greuter)

Milopotamos: hill between the Nida plain and Mt Skinakas, 1500 m, W- and NW-facing limestone cliffs, 11.8.1991, *Chilton & Turland* 224 (BM).

This is yet another population of this endemic taxon, which was originally known only from a single valley in the Lefka Ori in western Crete but has since been recorded from several new localities (Turland, 1992: 349). This extra locality is worthy of mention because it is in the immediate area where Baldacci collected the species in 1899 (BM!). For fuller details, and a distribution map for the species, see Turland (loc. cit.).

LABIATAE

Phlomis x ***cytherea*** Rech.fil. (new record)

= *P. cretica* C.Presl x *P. fruticosa* L.

Agios Vasilios: between Sellia and Kotsifos gorge N of Plakias, 300 m, phrygana at side of road, 10.4.1989, *Turland* 79 (BM).

This natural hybrid was originally described from the island of Kithira (Rechinger in Greuter & Rechinger, 1967: 115). The record cited here appears to be the first from Crete. The collection is morphologically intermediate between the parents, which are both common at the locality.

LEGUMINOSAE

Astragalus idaeus Bunge

According to Strid (1986: 472), this little-known species is apparently endemic to the high mountains of central and eastern Crete. It has been collected only twice, once by Fischer in the Psiloritis massif and once by Heldreich in the Dikti massif of eastern Crete (the former being the type collection). It is apparently similar to *Astragalus agraniotii* Orph., endemic to Mt Parnon in the south-eastern Peloponnisos. It would be surprising if *A. idaeus* has become extinct, since its dwarf habit should provide some protection from overgrazing, which is the only likely threat. However, the species is not recorded by Zaffran (1990), who has collected extensively in the high mountains of Crete. Confirmation of its continued existence would be welcome.

MALVACEAE

Abutilon theophrasti Medicus (confirmation)

Apokoronos: Kalives, 25 m, waste ground, 10.1990, *Chilton* obs. **Agios Vasilios**: Plakias, 3 m, waste ground in the village, 8.1991, *Chilton* s.n.! (BM).

Greuter (1974: 156) considers old records by Sieber to be doubtful. Chilton's records confirm the presence of this species in Crete, and his collection from Plakias matches material at BM from Nafplio in the Peloponnisos. It seems likely that the plant has been fairly recently introduced to Crete, in view of its weedy habitat, occurrence in touristic areas, and the lack of records since Sieber's times. Its European distribution includes the Mediterranean region, although its native status is doubtful west of the Balkan peninsula (Webb, 1968).

RANUNCULACEAE

Nigella arvensis subsp. *brevifolia* Strid

Pirgiotissi: 0.75 km NE of Kamilari, by the track from the village to the main Timbaki-Matala road, 50 m, cultivated soil in open olive grove, 7.7.1991, *Chilton* s.n. (BM!).

According to Strid (1970: 47), this taxon has been collected only twice in Crete, on both occasions in the north-west, but not within the last 100 years and is, therefore, mapped as presumably extinct by Jalas & Suominen (1989: 33, map 1541). The new locality confirms its continued existence on the island, the specimen clearly agreeing with one of the old Cretan collections cited by Strid (**Kissamos**, 2.7.1884, *Reverchon* (BM!)). According to Chilton, the habitat is not, at present, threatened by intensive agriculture of the type practised on the nearby Messara plain, with its extensive polythene greenhouses and copious use of fertilizers and herbicides. The only other known localities for this obscure subspecies are on the east Aegean island of Rodos, where it is apparently common, and the nearby small islands of Halki and Alimia (Strid, op. cit.: 45).

SCROPHULARIACEAE

Cymbalaria microcalyx subsp. *dodekanesi* Greuter (confirmation)

Sitia: gorge NW of Toplou monastery, 50 m, crevices of calcareous rock, 30.3.1990, *Turland* 114 p.p. (BM) & living material (hort. Turland).

The Balkan and south Aegean *Cymbalaria microcalyx* (Boiss.) Wettst. has a very disjunct distribution in Crete, occurring on the far western coast as subsp. *microcalyx*, which is otherwise found in the Peloponnisos and on Kithira, and at the far eastern end of the island, where the precise identity of the plants was unknown (Greuter, Matthäs & Risse, 1984b: 290). Greuter et al. (loc. cit.) suggested that the eastern population might belong to subsp. *dodekanesi*, which was already known within the Cretan area on Karpathos and Saria and, outside Europe, on the east Aegean island of Rodos (Greuter in Greuter & Rechinger, 1967: 108). At the Toplou locality the population is a mixture of glabrous plants with small, fleshy leaves and pubescent plants with slightly larger, less fleshy leaves. The two grow together, often in the same crevices but retain their individual characters when separated and grown in cultivation. The pubescent plant agrees with subsp. *dodekanesi*, thereby confirming the presence of this taxon in Crete. Fruits have been produced in cultivation to enable this determination. The glabrous plants have also fruited and proved not to be subsp. *dodekanesi*. They probably belong to the south Aegean and eastern Mediterranean *C. longipes* (Boiss. & Heldr.) A.Cheval., which is recorded by Zaffran (1990: 290) from the same two areas of Crete in which *C. microcalyx* occurs.

MONOCOTYLEDONES

ARACEAE

Arum cyrenaicum Hruby (new record)

Selinos: near Vlithias on Paleohora-Kandanos road, on E side of road, 200 m, 9.4.1984, *M.Briggs* obs.; same locality, 28.3.1988, *M.Briggs* living material (hort. P.Boyce); same area but 0.25km to S, on W side of road, 100 m, 28.3.1988, *M.Briggs* s.n. (K)—det. P.Boyce (Kew); same area but 1 km to N, on E side of road, 250 m, 28.3.1988, *M.Briggs* obs.; small ravine/valley 1.5 km NE of Vlithias, 300 m, 28.3.1991, *Turland* 402 (K) & living material (hort. P.Boyce)—det. P.Boyce; near Epanohori N of Sougia, 570 m, 20.3.1989, *E.Markus* colour transparency (K!)—det. P.Boyce.

This species was formerly considered endemic to Cyrenaica in north-eastern Libya. These records from Crete are the first for Europe. Mrs Mary Briggs, who first discovered the plant in Crete, has kindly supplied data, which are quoted here:

'The first sighting at Vlithias, on 9th April 1984, was of seven flowering plants, which had very dark brownish-purple spathes and pale yellow spadices. They were growing in natural vegetation at the edge of a cultivated plot. Photographs were taken and later shown to staff at Kew, but no determination was made. A return visit to the same locality was made on 28th March 1988, in order to collect material, at the request of Peter Boyce at Kew. Two plants were collected, with greenish spathes, purplish at the margins. They were later successfully grown by Peter Boyce. On the western side of the road, 0.25 km to the south, some individuals with very dark spathes were growing out of rock, with tubers firmly embedded. It was impossible to collect living material here but one herbarium specimen was taken. Approximately 1 km to the north, on the eastern side of the road, more individuals were seen growing out of and between rocks and boulders, and out of a low cliff above a stream. In 1991 the plants were identified by Peter Boyce as *Arum cyrenaicum* Hruby.'

At the author's locality north-east of Vlithias, the plants were growing in woodland of *Platanus orientalis* L., associated with *Arum concinnatum* Schott, *Cyclamen creticum* Hildebr., *Hedera helix* L. and *Tamus communis* L. The spathes were either unfurled or almost so, whereas none of the plants of *Arum concinnatum* (distinguishable by the different leaves) had even an immature inflorescence present. This early flowering-period and the superficial resemblance to the common and widespread *A. concinnatum* might account for *A. cyrenaicum* having remained undiscovered in Crete for so long. At present, the species appears restricted to the eparhia of Selinos in the far south-western part of the island. A fuller account of the Cretan occurrence is being prepared by Briggs.

Biarum tenuifolium Schott

Greuter (1973: 78) cites four Cretan localities for *Biarum zelebori* Schott. Three of these, however, are referable to *B. tenuifolium* subsp. *idomenaeum* Boyce & Athanasiou, and are included among the specimen citations accompanying the description of this new, apparently endemic taxon (Boyce & Athanasiou, 1991). The collection from the fourth locality cited by Greuter (**Pedias**: N slopes of Mt Kouna above

Milliarado, 21.10.1966, *Greuter* 7777 (B, G)) is confirmed by Boyce (pers. comm., 1991) as belonging to *B. tenuifolium* subsp. *tenuifolium* var. *zelebori* (Schott) Engler (taxonomy: Boyce, in prep.). Boyce knows of no other localities in Crete for this eastern Aegean and south-western Anatolian taxon.

CYPERACEAE

Carex illegitima Cesati (confirmation)

Ierapetra: 1 km SW of Thripti, 650 m, woodland of *Pinus brutia* Ten., 24.4.1991, *Turland* 427 (BM).

The only Cretan record for this species, by Gandoger, was considered doubtful and in need of confirmation by Greuter (1974: 162), and the Cretan area is omitted from the distribution given in *Flora Europaea* (Chater, 1980: 313), although it is listed as doubtfully present in Crete by Barclay (1986: 104). The plants are frequent in the field-layer of the pine woodland south-east of Thripti and the material collected agrees with specimens at BM from the Greek mainland. Outside Crete, the species is found on the island of Pantelleria west of Sicily, along the western coasts of Yugoslavia and Greece, on some of the East Aegean Islands, in western Turkey, and in Cyprus (Chater, loc. cit.; Nilson, 1985: 88).

GRAMINEAE

Sesleria doerfleri Hayek

Rethimni: upper part of Prassiano gorge E of Prassies, 100 m, E-facing limestone cliff, 6.8.1991, *Turland* obs. **Amari**: N side of Mt Kedros above Gerakari, 1300 m, N-facing limestone cliff, 10.8.1991, *Turland* obs.

This uncommon, endemic grass is an obligate chasmophyte with only five previously known localities all in western Crete (Greuter, Matthäs & Risse, 1985: 38). The two new populations extend the known distribution into central Crete and expand the altitudinal range (formerly considered to be 350–1000 m). The author has seen the plant on several occasions at one of the localities cited by Greuter et al. (**Agios Vasilios**: Kotsifos gorge N of Plakias). It is a very distinctive species and cannot be mistaken for other Cretan grasses.

LILIACEAE

Colchicum cupanii Guss. (confirmation)

Pedias: near Hersonissos, 300 feet, low limestone hills in company with *Ranunculus bullatus* L. and *Crocus laevigatus* Bory & Chaub., 15.12.1939, *Davis* 1096 (K!). **Mirambello**: between Milatos and Kounali NNW of Neapoli, 3 km after Milatos, 300 m, stony limestone hillside, 6.11.1980, *Brickell & Mathew* 10149 (retained by Brickell); between Vrahassi and Voulismeni WNW of Neapoli, 200 m, olive groves, plants abundant with very wide leaves and sometime white-flowered, 12.11.1980, *Brickell & Mathew* 10260 (retained by Brickell); E of Latsida on road to Neapoli, 320 m, stony limestone hillside with *Calicotome villosa* (Poiret) Link, *Phlomis & Pistachia*, mixed with *Colchicum pusillum* Sieber, 6.11.1980, *Brickell & Mathew* 10145 (retained by Brickell).

Greuter (1974: 161) rejects Cretan records of this Mediterranean species as either very doubtful or definitely erroneous. Among the very doubtful ones, he mentions a record by Turrill (1941: 266) which is, in fact, a citation of the Davis collection detailed above. The specimen at Kew has been determined as *Colchicum cupanii* Guss. by K.Persson (Göteborg) and, according to Mathew (pers. comm., 1991), there is no doubt that *C. cupanii* occurs in Crete.

Gagea fibrosa (Desf.) Schultes & Schultes fil. (confirmation)

Agios Vasilios: 3 km NE of Plakias, col immediately E of the summit of Mt Kirimianou, 600 m, dry stony hillside, approx. 20 plants seen, 4.4.1991, *M.J.Y.Foley* s.n. (LANC)—conf. E.M.Rix.

Mr Michael Foley has kindly supplied data, which is quoted here:

'Their overall height was rarely more than 5 cm, and they invariably possessed only solitary flowers borne on very short stems such that the cauline leaves were distinguished only with difficulty from the basal. Most characteristic was the shape (elongate-acuminate) of the perianth-segments which were of typical colour: bright yellow above and greenish beneath. The single basal leaf was *c.* 3 mm wide and more or less canaliculate, rigid and tortuous. Two or three bulbs examined showed a dense, fibrous network of roots but no prominent fibrous collar. There was no evidence of stolons bearing bulbils, and the plants occurred in isolation from each other.'

Foley's is perhaps the first Cretan record of this species, which is otherwise found elsewhere in the Aegean region, south-western Asia, North Africa and Arabia. The plant was recorded by Sieber over 170 years ago (as *Ornithogalum fibrosum* Desf.), but Greuter (1973: 66) suggested that this might be referable to *Gagea commutata* K.Koch, which he gives as new to Crete, citing a Davis collection from the east of the island and one of his own from the Psiloritis massif. In *Flora Europaea*, Richardson (1980: 27) does not include the Cretan area in the distribution of *G. fibrosa*.

ACKNOWLEDGEMENTS. I am firstly grateful to Lance Chilton for jointly carrying out some of the field-work with me and supplying voucher specimens and field-data for his own records. I should like to thank Dr John Richards (University of Newcastle-Upon-Tyne) for determining my Cretan collections of *Taraxacum*, supplying data concerning his own collections, and for other valuable advice. I am also most grateful to Mary Briggs for her notes on *Arum cyrenaicum*, Michael Foley for his notes on *Gagea fibrosa*, Dr Brian Mathew (Kew) for records of *Colchicum cupanii*, Sir Colville Barclay for his record of *Atractylis gummifera*, Peter Boyce (Kew) for advice on *Biarum tenuifolium*, and Chris Wilson for reporting *Ipomoea imperati*.

REFERENCES

Ball, P.W. 1964a. *Kochia* Roth *In*: T.G. Tutin et al. (Eds.). *Flora Europaea* **1**: 98–99. Cambridge.

—— 1964b. *Noaea* Moq. *In*: T.G. Tutin et al. (Eds.). *Flora Europaea* **1**: 107. Cambridge.

Barclay, Sir C. 1986. Crete, checklist of the vascular plants. *Englera* **6**.

Bonafè Barceló, F. 1979. *Flora de Mallorca* **3**. Editorial Moll, Palma de Mallorca.

Boyce, P. (in prep.) A revision of the genus *Biarum* Schott.

—— **& Athanasiou, K.** 1991. A new subspecies of *Biarum tenuifolium* (*Araceae*) from Crete. *Fl. Medit.* **1**: 5–13.
Chater, A.O. 1980. *Carex* L. *In*: T.G. Tutin et al. (Eds.). *Flora Europaea* **5**: 290–323. Cambridge.
Coulandris, N.A., Goulimis, C.N. & Stearn, W.T. 1968. *Wild flowers of Greece*. Goulandris Botanical Museum, Kifissia.
Goulimis, C.N. 1956. *New additions to the Greek flora.* Athens.
Greuter, W. 1973. Additions to the flora of Crete, 1938–1972. *Annales Musei Goulandris* **1**: 15–83.
—— 1974. Floristic report on the Cretan area. *Mem. Soc. Brot.* **24**: 131–171.
Greuter, W., Matthäs, U., & Risse, H. 1984a. Additions to the flora of Crete, 1973–1983—I. *Willdenowia* **14**: 27–36.
—— 1984b. Additions to the flora of Crete, 1973–1983 (1984)—II. *Willdenowia* **14**: 269–297.
—— 1985. Additions to the flora of Crete, 1973–1983 (1984)—III. *Willdenowia* **15**: 23–60.
—— **Pleger, R. & Raus, T.** 1983. The vascular flora of the Karpathos island group (Dodecanesos, Greece). A preliminary checklist. *Willdenowia* **13**: 43–78.
—— **& Rechinger, K.H.** 1967. Flora der Insel Kythera, gleichzeitig Beginn einer nomenklatorischen Überprüfung der griechischen Gefäßpflanzenarten. *Boissiera* **13**.
Jalas, J. & Suominen, J. 1980; 1989. *Atlas Florae Europaeae. Distribution of vascular plants in Europe.* **5**; **8**. Helsinki.
Nilsson, Ö. 1985. *Carex* L. *In*: P.H. Davis (Ed.). *Flora of Turkey and the East Aegean Islands* **9**: 73–158. Edinburgh.
Rechinger, K.H. 1943a. Flora Aegaea. Flora der Inseln und Halbinseln der ägäischen Meeres. *Denkschr. Akad. Wiss. Math.–Nat. Kl. (Wien)* **105**(1).
—— 1943b. Neue Beiträge zur Flora von Kreta. *Denkschr. Akad. Wiss. Math.–Nat. Kl. (Wien)* **105**(2/1).
—— 1949. Florae aegaeae supplementum. *Phyton (Horn)* **1**: 194–228.
Richards, A.J. 1991. *Taraxacum* Wiggers *In*: A. Strid & Kit Tan (Eds.). *Mountain Flora of Greece* **2**: 541–572. Edinburgh.
—— **& Sell, P.D.** 1976. *Taraxacum* Weber *In*: T.G. Tutin et al. (Eds.). *Flora Europaea* **4**: 332–343. Cambridge.
Richardson, I.B.K. 1980. *Gagea* Salisb. *In*: T.G. Tutin et al. (Eds.). *Flora Europaea* **5**: 26–28. Cambridge.
Soest, J.L. van 1975. *Taraxacum* Wiggers *In*: P.H. Davis (Ed.). *Flora of Turkey and the East Aegean Islands* **5**: 788–812. Edinburgh.
Strid, A. 1970. Studies in the Aegean flora XVI. Biosystematics of the *Nigella arvensis* complex. With special reference to the problem of non-adaptive radiation. *Opera Bot.* **28**.
—— 1986. *Astragalus* L. *In*: A. Strid (Ed.). *Mountain Flora of Greece* **1**: 460–478. Cambridge.
Turland, N.J. 1992. Floristic notes from Crete. *Bot. J. Linn. Soc.* **108**: 345–357.
Turrill, W.B. 1941. On the flora of the Nearer Esat XXII. New records and new species from Greece and the greek Islands. *Kew Bull.* **1940**: 262–266.
Webb, D.A. 1968. *Abutilon* Miller *In*: T.G. Tutin et al. (Eds.). *Flora Europaea* **2**: 254–255. Cambridge.
Yannitsaros, A.G. 1971. Notes on the flora of Elaphonesos island (Laconia, Greece). *Biol. Gallo-Hellen.* **3**: 149–162.
Zaffran, J. 1990. *Contributions à la flore et à la végétation de la Crète.* Université de Provènce.

Bull. Br. Mus. nat. Hist. (Bot.) **22**(2): 165–169 Issued 26 November 1992

Studies on the Cretan flora 2. The *Dianthus juniperinus* complex (Caryophyllaceae)

NICHOLAS J. TURLAND

Ludlow House, 12 Kingsley Avenue, Kettering, Northamptonshire NN16 9EU

SYNOPSIS. The Cretan endemic *Dianthus juniperinus* Sm. is treated as a complex of seven subpecies: subsp. *pulviniformis* (Greuter) N.J.Turland comb. et stat. nov., subsp. *juniperinus*, subsp. *heldreichii* Greuter, subsp. *idaeus* N.J.Turland subsp. nov., subsp. *kavusicus* N.J.Turland subsp. nov., subsp. *aciphyllus* (Sieber ex Ser.) N.J.Turland comb. et stat. nov., and subsp. *bauhinorum* (Greuter) N.J.Turland comb. et stat. nov. Morphological and distributional data are provided, including a key to the taxa recognized.

INTRODUCTION

This paper is the second in a series resulting from ongoing research connected with the Natural History Museum's project to compile an annotated checklist, with distribution maps, of the vascular flora of the Cretan area in the south Aegean region. The 'Cretan area' is the floristic territory defined by *Flora Europaea*, and includes the islands of Kasos, Karpathos and Saria to the north-east of Crete itself.

The *Dianthus juniperinus* complex is endemic to the main island of Crete, where the plants grow as obligate chasmophytes on vertical, calcareous cliffs. The extremely rugged nature of the landscape, with abundant mountains and deep gorges, limits the extent to which such specialized plants can migrate. Genetic drift in isolated population-groups of a species can eventually result in a complex of closely related taxa. This process probably explains the particularly high degree of differentiation within *D. juniperinus*, in which seven taxa can be recognized altogether. In this respect, *D. juniperinus* can be likened to another chasmophyte, *D. fruticosus* L., within which Runemark (1980) recognized eight allopatric subspecies distributed in the Ionian islands, the southern Peloponnisos and the south Aegean islands. The *Erysimum cheiri* complex (*Cruciferae*) is also chasmophytic, and behaves similarly, with various species and subspecies endemic to islands and island-groups in the Aegean region (Snogerup, 1967).

Tutin (1964) treated the complex as a single species, *Dianthus juniperinus* Sm., with no infraspecific variation, and included *D. aciphyllus* Sieber ex Ser. in synonymy. Greuter (1965), however, recognized five taxa, based upon material available to him, describing three as new.

D. juniperinus Sm. subsp. *juniperinus* from the western half of the district of Sfakia in western Crete.

D. juniperinus subsp. *heldreichii* Greuter from the eastern half of the district of Sfakia.

D. pulviniformis Greuter from Mount Kedros in central Crete.

D. aciphyllus var. *bauhinorum* Greuter from the area east of the Psiloritis mountain massif, again in central Crete but further east than Kedros.

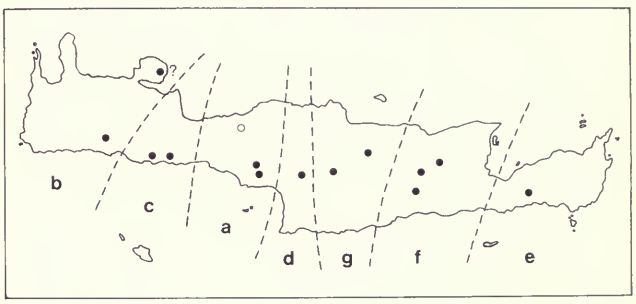


Fig. 1 Distribution of *Dianthus juniperinus* in Crete: a. subsp. *pulviniformis*; b. subsp. *juniperinus*; c. subsp. *heldreichii*; d. subsp. *idaeus*; e. subsp. *kavusicus*; f. subsp. *aciphyllus*; g. subsp. *bauhinorum*. Open circle indicates indeterminate subspecies. Question-mark indicates doubtful locality.

D. aciphyllus Sieber ex Ser. var. *aciphyllus* from the Dikti mountain massif (Lasithiotika Ori) in eastern Crete.

This arrangement can no longer be justified, in the light of subsequent collections augmenting the rather scanty material available to botanists during the early 1960s, and especially because of new information provided by a recent gathering by Chilton and Turland, from central Crete, and one made in 1938 by Barneby and Davis in eastern Crete and apparently not seen by Greuter. If these two are disregarded, then there are clear-cut discontinuities between *Dianthus juniperinus* and *D. aciphyllus*. The former has pale pink or bright pink flowers opening together, while those of the latter are pinkish-purple with darker markings and do not open together (i.e. immature buds at various stages of development are present during the greater part of anthesis). Furthermore, *D. juniperinus* has calyces 10–13 mm long and flowers small, the petal-limb 3–4.5 mm, whereas those of *D. aciphyllus* measure 15–23 mm and 7–14 mm respectively. However, the new collection from central Crete is similar to *D. juniperinus* but has a petal-limb measuring 6–7 mm, while Barneby and Davis's collection has flowers matching *D. aciphyllus* in colour but all opening together, with calyces (13–)14 mm long and petal-limb 6 mm. It is necessary, therefore, to combine *D. aciphyllus* within *D. juniperinus* (the earlier name) because there now exists a continuous range of variants, from the small-flowered *D. juniperinus* subsp. *juni-*

perinus to the large-flowered *D. aciphyllus* var. *bauhinorum*. The two varieties of *D. aciphyllus* are better placed at at subspecific rank, since they differ from each other in more than one character and have discrete distributions.

The maintenance of *Dianthus pulviniformis* at specific rank is inappropriate because the plant is clearly very close to typical *D. juniperinus*, differing only in usually being smaller. The single clear-cut discontinuity is the size of the calyx, which is 7–9 mm long (other taxa 10–23 mm). It is better, therefore, to treat this plant, too, as a subspecies of *D. juniperinus*.

The description of *Dianthus pulviniformis* is somewhat misleading. The plant is said to have flowers not opening together, although more recent observations show this not to be the case. The illustration of the type specimen, accompanying the description, shows a plant which is just beginning to flower, with several buds present, all apparently in an advanced stage of development. This gives a wrong impression of the taxon. Had the specimen been collected one week later, all flowers probably would have been open and the affinities with *D. juniperinus* made less obscure. It is also stated that the flowers are white, although the colour has been pale pink in all the plants seen in the field by the author.

In April 1989 sterile material of a *Dianthus* obviously belonging to the *D. juniperinus* complex was collected in a gorge near Kamares on the southern side of the Psiloritis mountain massif in central Crete. It subsequently flowered in cultivation in Britain and has proved to be close to *D. juniperinus* subsp. *juniperinus*, on account of its calyces, which are 10–11 mm long, and its pale pink flowers. It differs strikingly, however, in its large petals, which have a limb 6–7 mm long. This feature is unlikely to be attributable to the effects of cultivation under glass in Britain, since other taxa have been grown alongside the Kamares plant and their flowers have remained identical in size to those of wild individuals. The geographical position of the Kamares population is significant, being discrete from the ranges of all other taxa and considerably disjunct from that of *D. juniperinus* subsp. *juniperinus* to the west (two other taxa present in the area between). Upon this evidence the Kamares plant is described here as a new subspecies within the complex. The epithet *idaeus* has been chosen, after Mount Ida, the ancient name for the Psiloritis massif where the new plant is found.

One collection in the Kew herbarium, labelled as *Dianthus juniperinus* var. *sieberi* Boiss., has a combination of features which make it impossible to assign to any of the six taxa recognized so far. It was gathered by Barneby and Davis in 1938, on Mount Skliros north of Mount Afendis Kavousi (Afendis Stavromenos), on the border of the eparchies of Ierapatra and Sitia in eastern Crete. This extends the distribution of the complex eastward from the Dikti massif. The inflorescences have 9–10 crowded flowers opening together, the calyces are (13–)14 mm long and the petals are pinkish-purple with darker markings, the limb 6 mm long. In view of all this, it seems appropriate to treat the plant as another, new, seventh subspecies in the complex. The epithet *kavusicus* has been chosen, referring to Mt Afendis Kavousi, the highest peak in the range of mountains where the plant was collected.

SYSTEMATIC TREATMENT

Key to the subspecies of *Dianthus juniperinus*

1a. Leaves 0.4–1.5 mm wide; epicalyx scales *c.* 1/2 as long as calyx; calyx 7–13 mm; petal-limb 3–7 mm, pale or bright pink:
  2a. Calyx (10–)12–13 mm; flowers bright pink ..... c. subsp. **heldreichii**
  2b. Calyx 7–11(–12) mm; flowers pale pink:
    3a. Leaves 0.4–0.8 mm wide; calyx 7–9 mm ..... a. subsp. **pulviniformis**
    3b. Leaves 1–1.5 mm wide; calyx 10–11(–12) mm:
      4a. Petal-limb 3–4.5 mm ..... b. subsp. **juniperinus**
      4b. Petal-limb 6–7 mm ..... d. subsp. **idaeus**

1b.:Leaves 1–3.1 mm wide; epicalyx scales c. 1/3 as long as calyx; calyx (13–)14–23 mm; petal-limb 6–14 mm, pinkish-purple with darker stripes:
  5a. Calyx (13–)14 mm; petal-limb 6 mm ..... e. subsp. **kavusicus**
  5b. Calyx 15–23 mm; petal-limb 7–14 mm:
    6a.:Leaves 1–1.9 mm wide, linear; petal-limb 7–11 mm ..... f. subsp. **aciphyllus**
    6b. Leaves 1.6–3.1 mm wide, linear to linear-lanceolate; petal-limb 8–14 mm ..... g. subsp. **bauhinorum**

1. **Dianthus juniperinus** Sm. in *Trans. Linn. Soc. London (Bot.)* ser.1, **2**: 303 (1794). Type: Crete, *Gundelsheimer & Tournefort* (LINN-holotype).

Shrubby, glabrous perennial with densely leafy vegetative shoots normally forming cushions. *Leaves* 10–40 × 0.4–3.1 mm, flat or slightly involute, coriaceous, linear to linear-lanceolate; apex acute. *Flowering stems* numerous, herbaceous, 3–30 cm with 3–4 pairs of leaves. *Inflorescence* with 1–10(–12) flowers opening together or gradually (i.e. with immature buds at various stages of development present during greater part of anthesis). *Epicalyx-scales* 4–8, *c.* 1/3 to 1/2 as long as calyx, obovate or sometimes obcordate; apex subulate. *Calyx* 7–23 mm, nearly cylindrical; teeth 3–6 mm, acute. *Petal-limb* 3–14 mm, orbicular-obtriangular, dentate, bearded, pale or bright pink, or pinkish-purple with darker stripes.

FLOWERING TIME. June to September.

ECOLOGY. Crevices and ledges of vertical, calcareous cliffs.

DISTRIBUTION. Endemic to Crete, where widespread, occurring at altitudes between 600 and 1750 m.

a. subsp. **pulviniformis** (Greuter) N.J.Turland **comb. et stat. nov.** Basionym: *D. pulviniformis* Greuter in *Candollea* **20**: 189 (1965). Type: Crete, Agios Vasilios, ad parietes deruptorum meridionalium montis Kedros, prope pagum Kria Vrisi, *Snogerup, Strid & von Bothmer* 20955 (LD-holotype).

Icon. Greuter (1965: 190).

Leaves 10–20 × 0.4–0.8 mm, linear. *Flowering stems* 3–8.5 cm. *Inflorescence* with 1–4 flowers opening together. *Epicalyx-scales c.* 1/2 as long as calyx. *Calyx* 7–9 mm; teeth 3–3.5 mm. *Petal-limb* 4 mm, pale pink.

DISTRIBUTION. Mount Kedros in central Crete, 600–1300 m.

SPECIMENS EXAMINED. **Crete**: Agios Vasilios: in faucibus supra Palea Kria Vrisi ad latus montis Kedros, 750 m,

2.11.1966, *Greuter* 7863 (K). Amari: north side of Mt Kedros above Gerakari village, 1300 m, 10.8.1991, *Turland* 548 (BM).

b. subsp. **juniperinus**

Icon. Greuter (1965: 188).

Leaves 15–30 × 1–1.5 mm, linear. *Flowering stems* 8–20 cm. Inflorescnce with 2–6(–7) flowers opening together. *Epicalyx-scales c.* 1/2 as long as calyx. *Calyx* 10–11(–12) mm; teeth 3–4 mm. *Petal-limb* 3–4.5 mm, pale pink.

DISTRIBUTION. Western half of district of Sfakia in western Crete, 1400–1750 m; doubtfully on Akrotiri peninsula north-east of Hania (see Supplementary Notes).

SPECIMENS EXAMINED. **Crete**: Sfakia: in rupestribus l.d. Linoseli m. Volakia, 8.7.1893, *Baldacci* 54 (BM, K); between Mt Strifomadi & the Xiloskala pass, 1450–1500 m, 8.8.1991, *Turland* obs. ?Kidonia: pr. Acrotiri, Jul? 1932, *Guiol* 2129 (BM).

c. subsp. **heldreichii** Greuter in *Candollea* **20**: 187 (1965). Type: Crete, Sfakia, fauces Sfakiano, in rupe Asprokremnos, 600 m, *Heldreich* 1640 (G-Bs-holotype; scheda gallica, BM!, FI, G, G-Bs, G-Bu, K!, W-Hal-isotypes).

Icon. Greuter (1965: 188).

Leaves (13–)15–25 × 0.5–1.4 mm, linear. *Flowering stems* 6–13 cm. *Inflorescence* with 1–4 flowers opening together. *Epicalyx-scales c.* 1/2 as long as calyx. *Calyx* (10–)12–13 mm; teeth 3–4 mm. *Petal-limb* 4 mm, bright pink.

DISTRIBUTION. Eastern half of district of Sfakia in western Crete, 600–650 m.

SPECIMENS EXAMINED. **Crete**: 1846, *Heldreich* (BM, K). Sfakia: in rupe Asprokremno dicta Sphakia, 7.1846, *Heldreich* (BM, K); in faucibus montium Sphacioticorum Cretae, 7.1846, *Heldreich* (BM, K); gorge south of Asfendos, 500 m, 21.4.1989, *Chilton & Turland* 10 (BM).

Fig. 2 *Dianthus juniperinus* subsp. *kavusicus*: a. habit; b. flower. *D. juniperinus* subsp. *idaeus*: c. habit; d. flower.

Table 1 Comparison of features of subspecies of *Dianthus juniperinus*.

Subspecies	Size of leaves	Length of flg stems	Flowers per infl.	Flowers opening	Epicalyx: calyx ratio	Length of calyx	Length of calyx-teeth	Length of petal-limb	Colour of petal-limb
pulviniformis	10–20 ×0.4–0.8mm	3–8.5cm	1–4	together	*c.* 1:2	7–9mm	3–3.5mm	4mm	pale pink
juniperinus	15–30 ×1–1.5mm	8–20cm	2–6(–7)	together	*c.* 1:2	10–11(–12)mm	3–4mm	3–4.5mm	pale pink
heldreichii	(13–)15–25 ×0.5–1.4mm	6–13cm	1–4	together	*c.* 1:2	(10–)12–13mm	3–4mm	4mm	bright pink
idaeus	20–30 ×1–1.3mm	9.5–13.5cm	2–5	together	*c.* 1:2	10–11mm	3.5mm	6–7mm	pale pink
kavusicus	17–26 ×1–1.3mm	8.5–10cm	9–10	together	*c.* 1:3	(13–)14mm	4mm	6mm	pink-purple, with stripes
aciphyllus	16–40 ×1–1.9mm	11–30cm	(1–)2–6	not together	*c.* 1.3	15–22mm	4–6mm	7–11m	pink-purple, with stripes
bauhinorum	21–40 ×1.6–3.1mm	13–30cm	2–6(–12)	not together	*c.* 1:3	16–23mm	4–6mm	8–14mm	pink-purple, with stripes

d. subsp. **idaeus** N.J.Turland **subsp. nov.** Subsp. *juniperino* Sm. affinis, sed floribus maioribus differt. Type: Crete, Pirgiotissi, gorge 0.75 km NW of Kamares village, 600 m, 16.4.1989, *Turland & Chilton* 8 (BM-holotype); same locality, ex hort. Turland (with flowers), 10.7.1991 (BM-paratype).

Leaves 20–30 × 1–1.3 mm, linear. *Flowering stems* 9.5–13.5 cm. *Inflorescence* with 2–5 flowers opening together. *Epicalyx-scales c.* 1/2 as long as calyx. *Calyx* 10–11 mm; teeth 3.5 mm. *Petal-limb* 6–7 mm, pale pink.

DISTRIBUTION. Gorge north-west of Kamares village on southern edge of Psiloritis massif in central Crete, 600 m.

NOTE. The flowering stem of the paratype specimen measures 23 cm. This is probably abnormally tall, a result of the light-levels prevalent during its development in cultivation in Britain being lower than those at the type locality in Crete.

e. subsp. **kavusicus** N.J.Turland **subsp. nov.** Subsp. *juniperino* Sm. affinis, sed floribus numerosioribus in inflorescentiis 9–10-floris dispositis, calyce longiore, limbo petali longiore striis subroseis-purpureis ornato, differt. Type: Crete, Ierapetra-Sitia, Skliros E. [sic] of Mt Kavutsi, 3000 ft, 9.1938, *Barneby & Davis* (K-holotype).

Leaves 17–26 × 1–1.3 mm, linear. *Flowering stems* 8.5–10 cm. *Inflorescences* with 9–10 flowers opening together. *Epicalyx-scales c.* 1/3 as long as calyx. *Calyx* (13–)14 mm; teeth 4 mm. *Petal-limb* 6 mm, pinkish-purple with darker stripes.

DISTRIBUTION. Mt Skliros north of Mt Afendis Kavousi (Afendis Stavromenos) between Ierapetra and Sitia in eastern Crete, 900 m.

f. subsp. **aciphyllus** (Sieber ex Ser.) N.J.Turland **comb. et stat. nov.** Basionym: *D. aciphyllus* Sieber ex Ser. in DC., *Prodr.* **1**: 358 (1824). Type: Crete, Lasithi, ad rupes prope pagum Tzermiado, *Sieber* (G-DC-holotype; G, G-Bs, K!-isotypes).

D. juniperinus var. *sieberi* Boiss., *Fl. Or.* **1**: 498 (1867). Type: same as that of *D. aciphyllus* Sieber ex Ser.

D. juniperinus var. *aciphyllus* (Sieber ex Ser.) Halácsy, *Consp. Fl. Graec.* **1**: 202 (1900), nom. illeg. (article 11.3).

Icon. Greuter (1965: 191).

Leaves 16–40 × 1–1.9 mm, linear. *Flowering stems* 11–30 cm. *Inflorescence* with (1–)2–6 flowers not opening together. *Epicalyx-scales c.* 1/3 as long as calyx. *Calyx* 15–22 mm; teeth 4–6 mm. *Petal-limb* 7–11 mm, pinkish-purple with darker stripes.

DISTRIBUTION. Dikti mountain massif (Lasithiotika Ori) in eastern Crete, 800–1700 m.

SPECIMENS EXAMINED. **Crete**: 24.5.1948, *Davis*—seed grown at Kew and specimens prepared 10.10.1951, 25.8.1952, 31.7.1953 & 8.8.1955, *K.* 2779 (K). Pedias: in latere septentrionali montis Kuna supra Miliarado, 750–850 m, 21.10.1966, *Greuter* 7775 (K); in rupestr. reg. sup. et mediae m. Aphendis Sarakeno, 15.6.1899, *Baldacci* 108 (BM); Mt Aphendi Sarakino, *Atchley* 1256 (K). Lasithi: ad rupes prope pagum Tzermiado, *Sieber* (K); Tzermiado, 3000 feet, 11.7.1938, *Davis* 284 (BM, K); in rupestribus Katavo[thra] Omalo Lassithi, 2.7.1899, *Baldacci* 108 bis (BM).

g. subsp. **bauhinorum** (Greuter) N.J.Turland **comb. et stat. nov.** Basionym: *D. aciphyllus* var. *bauhinorum* Greuter in *Candollea* **20**: 190 (1965). Type: Crete, Temenos, in rupestribus m. Joukta, 6.6.1899, *Baldacci* 57 (G-holotype; BM!, FI, G-Bu, W-Hal-isotypes).

Leaves 21–40 × 1.6–3.1 mm, linear to linear-lanceolate. *Flowering stems* 13–30 cm. *Inflorescence* with 2–6(–12) flowers not opening together. *Epicalyx-scales c.* 1/3 as long as calyx. *Calyx* 16–23 mm; teeth 4–6 mm. *Petal-limb* 8–14 mm, pinkish-purple with darker stripes.

DISTRIBUTION. From eastern edge of Psiloritis massif to Mount Giouhtas south of Iraklio in central Crete, 600–800 m.

SPECIMENS EXAMINED. **Crete**: Malevizi: in rupestribus supra Prinias, 4.6.1899, *Baldacci* 57 bis (BM). Temenos: in rupestribus m. Joukta, 6.6.1899, *Baldacci* 57 (BM); ad cacumen montis Juktas, 700 m, 14.9.1966, *Greuter* 7517 (K); summit of Mt Giouhtas, 800 m, 25.4.1989, *Turland* 86 (BM).

SUPPLEMENTARY NOTES

The correct provenance of Guiol's specimen of *Dianthus juniperinus* subsp. *juniperinus* at BM is obscure. The 'Acrotiri' mentioned on the label could refer to the Akrotiri peninsula north-east of the city of Hania, indeed the mountains there rise to 528 m on the peak called Skloha, which is almost as high as the lower altitudinal limit of some of the other taxa. However, this region is considerably disjunct from the area of the type locality, and none of the other taxa shows such a disjunction. The Greek word *akrotiri* means cape or headland, of which there are many around the coast of Crete. One possible explanation is that a particular cape was meant, but the distinguishing epithet omitted. It is also possible that the specimen was mis-labelled.

In autumn 1989 a *Dianthus* obviously belonging to the *D. juniperinus* complex was observed by the author in the middle part of the Prassiano gorge, south-east of Rethimno in central Crete. Unfortunately, no fertile parts were remaining and no material was collected owing to the inaccessibility of the plants. Subsp. *pulviniformis* and subsp. *idaeus* are the nearest taxa geographically.

ACKNOWLEDGEMENTS. I should like to thank Chris Hogg for drawing the illustrations, Bob Press for drawing the map and for helpful advice, and Marian West for translating the Latin diagnoses.

REFERENCES

Boissier, P.E. 1867. *Flora Orientalis* **1**. Basileae et Genevae.

Greuter, W. 1965. Beiträge zur Flora der Südägäis 1–7. *Candollea* **20**: 167–218.

Halácsy, E. von, 1900–1901. *Conspectus Florae Graecae* **1**. Lipsiae.

Runemark, H. 1980. Studies in the Aegean flora XXIII. The *Dianthus fruticosus* complex (*Caryophyllaceae*). *Bot. Not.* **133**: 475–490.

Snogerup, S. 1967. Studies in the Aegean flora VIII, IX. *Erysimum* sect. *Cheiranthus* A. Taxonomy. B. Variation and evolution in the small-population system. *Opera Bot.* **13, 14**.

Tutin, T.G. 1964. *Dianthus* L. *In*: T.G.Tutin et al. (Eds.). *Flora Europaea* **1**: 188–204. Cambridge.

Bulletin of the British Museum (Natural History)

Botany Series

Earlier Botany *Bulletins* are still in print. The following can be ordered from Intercept (address on inside front cover). Where the complete backlist is not shown, this may also be obtained from the same address.

Volume 5

No. 1 The dryopteroid ferns of Ceylon. W.A. Sledge. 1973. Pp. 1–43, 4 figs. **£3.00**

No. 2 New Himalayan and Tibetan species of *Corydalis* (Papaveraceae). F.Ludlow & W.T. Stearn. 1975. Pp. 45–69, 15 plates, 14 figs. **£3.85**

No. 3 The marine algae of Trinidad, West Indies. W.D.Richardson. 1975. Pp. 71–143, 12 plates, 2 figs. **£6.80**

No. 4 A revision of the Macaronesian genus *Argyranthemum* Webb ex Schultz Bip. (Compositae-Anthemideae).C.J. Humphries. 1976. Pp. 145–240, 2 plates, 26 figs. **£7.25**

No. 5 Frank Ludlow (1885–1972) and the Ludlow-Sherriff expeditions to Bhutan and south-eastern Tibet of 1933–1950. W.T. Stearn. 1976. Pp. 243–268, 1 fig. Reliquiae botanicae himalaicae. F. Ludlow. 1976. Pp. 269–289, 7 plates, 8 figs. **£5.25**

No. 6 Studies in the genus *Hypericum* L. (Guttiferae). 1. Infrageneric classification. N.K.B. Robson. 1977. Pp. 291–355, 9 figs. **£7.25**

No. 7 Sphagnales of tropical Asia. A.Eddy. 1977. Pp. 357–445, 4 plates, 17 maps, 25 figs. **£9.25**

Volume 6

No. 1 The handwriting of Joseph Banks, his scientific staff and amanuenses. J.B. Marshall. 1978. Pp. 1–85, 62 figs. **£9.50**

No. 2 Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. II. Phaeophyta. J.H. Price, D.M. John & G.W. Lawson. 1978. Pp. 87–182, 1 fig. **£15.00**

No. 3 The lichenicolous Hyphomycetes. D.L. Hawksworth. 1979. Pp. 183–300, 47 figs. **£15.00**

No. 4 The species of *Chisocheton* (Meliaceae). D.J. Mabberley. 1979. Pp. 301–386, 3 plates, 10 figs. **£15.00**

Volume 7

No. 1 The distribution of *Padina pavonica* (L.) Lamour. (Phaeophyta: Dictyotales) on British and adjacent European shores. J.H. Price, I. Tittley & W.D. Richardson. 1979. Pp. 1–67, 3 plates, 2 figs. **£9.00**

No. 2 Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. 111. Rhodophyta (Bangiophyceae). D.M. John, J.H. Price, C.A. Maggs, G.W. Lawson. 1979. Pp. 69–82, 1 fig. **£2.20**

No. 3 A revision of the genus *Anacyclus* L. (Compositae: Anthemideae). C.J. Humphries. 1979. Pp. 83–142, 27 figs. **£8.00**

Volume 8

No. 1 The Thelypteridaceae of Ceylon. W.A. Sledge. Pp. 1–54, 5 figs. 1981. **£7.75**

No. 2 Studies in the genus *Hypericum* L. (Guttiferae) 2. Characters of the genus. N.K.B. Robson. 1981. Pp. 55–226, 73 figs. **£23.50**

No. 3 A revision of the lichen family Thelotremataceae in Sri Lanka. M.E. Hale, Jr. 1981. Pp. 227–332, 20 figs. **£14.50**

No. 4 Vascular plant collections from the Tristan da Cunha group of islands. E.W. Groves. Pp. 333–420, 33 figs. **£12.50**

Volume 9

No. 1 The lichenicolous Coelomycetes. D.L. Hawksworth. 1981. Pp. 1–98, 36 figs. **£13.25**

No. 2 The genus *Callithamnion* (Rhodophyta: Ceramiaceae) in the British Isles. P.S. Dixon & J.H. Price. 1981. Pp. 99–141, 5 figs. **£6.00**

No. 3 *Parmelia* subgenus *Amphigymnia* (lichens) in East Africa. H. Krog & T.F.V. Swinscow. 1981. Pp. 143–231, 31 figs. **£12.25**

No. 4 The genus *Selaginella* in tropical South America. A.H.G. Alston, A.C. Jermy & J.M. Rankin. 1981. Pp. 233–330, 18 figs. **£13.50**

Volume 10

No. 1 Taxonomic studies in the Labiatae tribe Pogostemoneae. J.R. Press. 1982. Pp. 1–89, 33 figs. **£12.75**

No. 2 The typification of Hudson's algae: a taxonomic and nomenclatural reappraisal. L.M. Irvine & P.S. Dixon. 1982. Pp. 91–105. **£2.25**

No. 3 Seaweeds of the Faroes. Various authors. 1982. Pp. 107–225, 13 figs. **£16.75**

No. 4 The lichen genus *Steinera*. A.M. Henssen & P.W. James. 1982. Pp. 227–256, 24 figs. **£4.50**

Volume 11

No. 1 The algae of Lightfoot's *Flora scotica*. P.S. Dixon. 1983. Pp. 1–15, 2 figs. **£2.30**

No. 2 A taxonomic study of the lichen genus *Micarea* in Europe. B.J. Coppins. 1983. Pp. 17–214, 57 figs, 28 maps. **£27.75**

No. 3 The hepatics of Sierra Leone and Ghana. E.W. Jones & A.J. Harrington. 1983. Pp. 215–289, 8 figs. **£10.50**

No. 4 Studies in the Corallinaceae with special reference to *Fosliella* and *Pneophyllum* in the British Isles. Y.M. Chamberlain. 1983. Pp. 291–463, 89 figs. **£24.50**

Volume 12

No. 1 A revision of the Morinaceae (Magnoliophyta-Dipsacales). M.J. Cannon & J.F.M. Cannon. 1984. Pp. 1–35, 9 figs. **£5.40**

No. 2 An introduction to fern genera of the Indian subcontinent. C.R. Fraser-Jenkins. 1984. Pp. 37–76, 1 fig. **£6.00**

No. 3 A revision of African Sphagnales. A. Eddy. 1985. Pp. 77–162, 47 figs. **£13.50**

No. 4 Studies in the genus *Hypericum* L. (Guttiferae) 3. Sections 1. *Campylosporus* to 6a. *Umbraculoides*. N.K.B. Robson. 1985. Pp. 163–325, 24 figs, 34 maps. **£28.80**

Volume 13

No. 1 The lichen genus *Usnea* subgenus *Neuropogon*. F.J.

Walker. 1985. Pp. 1–130, 39 figs. **£19.80**

No. 2 Cytotaxonomic studies of the ferns of Trinidad. A.C. Jermy & T.G. Walker. 1985. Pp. 131–276, 69 figs. **£22.00**

No. 3 Some genera of the Biddulphiaceae (diatoms) with interlocking linking spines. R. Ross & P.A. Sims. 1985. Pp. 277–381, 33 plates. **£20.00**

Volume 14

No. 1 Cytological observations on Indian subcontinent and Chinese *Dryopteris* and *Polystichum* (Pteridophyta: Dryopteridaceae). M. Gibby. 1985. Pp. 1–42, 78 figs. **£6.00**

No. 2 A redisposition of the species referred to the ascomycete genus *Microthelia*. D.L. Hawksworth. 1985. Pp. 43–181, 73 figs. **£24.00**

No. 3 A classification of the genus *Cryopteris* (Pteridophyta: Dryopteridacaee). C.R. Fraser-Jenkins. 1986. Pp. 183–218, 4 figs. **£5.60**

No. 4 Evolutionary cladistics of marattialean ferns. C.R. Hill & J.M. Camus. 1986. Pp. 219–300, 27 figs. **£14.50**

Volume 15

No. 1 Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. IV. Rhodophyta (Florideae) 1. Genera A-F. J.H. Price, D.M. John & G.W. Lawson. 1986. Pp. 1–122, 1 fig. **£23.50**

No. 2 Cytology of the fern flora of Madeira. I. Manton, J.D. Lovis, G. Vida & M. Gibby. 1986. Pp. 123–161, 12 plates. **£7.50**

No. 3 A revision of the lichen genus *Xanthoparmelia* in Australasia. J.A. Elix, J. Johnston & P.M. Armstrong. 1986. Pp. 163–362, 42 figs, 117 maps. **£38.00**

Volume 16

No. 1 Studies in the genus *Hypericum* L. (Guttiferae) 7. Section 29. *Brathys* (part 1). N.K.B. Robson. 1987. Pp. 1–106, 14 figs, 25 maps. **£20.00**

No. 2 The lichen genus *Ramalina* in Australia. G.N. Stevens. 1987. Pp. 107–233, 15 plates, 31 figs. **£22.50**

No. 3 An annotated list of vascular plants collected in the valleys south of Mt Everest. G. Miehe. 1987. Pp. 225–268, 4 figs. **£8.50**

No. 4 Further genera of the Biddulphiaceae (diatoms) with interlocking linking spines. R. Ross & A.Sims. 1987. Pp. 269–311, 13 plates. **£8.00**

Volume 17

No. 1 Studies in *Pseudocyphellaria* (lichens) 1. The New Zealand species. D.J. Galloway. 1988. Pp. 1–267, 124 figs. **£51.00**

Volume 18

No. 1 An illustrated catalogue of the type specimens in the Greville diatom herbarium. D.M. Williams. 1988. Pp. 1–148, 74 plates. **£28.00**

No. 2 Erik Acharius and his influence on English lichenology. D.J. Galloway. 1988. Pp. 149–194, 18 figs. **£8.80**

No. 3 Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. IV. *Phodophyta* (Florideae) 2. Genera G.J.H. Price, D.M. John & G.W. Lawson. 1988. Pp. 195–273, 1 fig. **£14.80**

No. 4 Some Cretaceous and Palaeogene *Trinacria* (diatom) species. P.A. Sims & R. Ross. 1988. Pp. 275–322, 13 plates. **£9.10**

No. 5 A monograph of *Dryopteris* (Pteridophyta: Dryopteridaceae) in the Indian subcontinent. C.R. Fraser-Jenkins. 1989. Pp. 323–477, 79 figs. **£30.00**

No. 6 *Corydalis* (Papaveraceae: Fumarioideae) in Nepal. M. Lidén. 1989. Pp. 479–538, 26 figs. **£11.20**

Volume 19

A new species of *Maytenus* (Celastraceae) in Ethiopia. Sebsebe Demissew. 1989. Pp. 1–3, 1 fig.

Central American Araliaceae – a precursory study for the *Flora Mesoamericana*. M.J. Cannon & J.F.M.Cannon. 1989. Pp. 5–61, 36 figs.

A revision of the *Solanum nitidum* group (section *Holophylla* pro parte): Solanaceae. S. Knapp. 1989. Pp. 63–102, 21 figs.

Six new species of *Solanum* sect. *Geminata* from South America. S. Knapp. 1989. Pp. 103–112, 8 figs.

The application of names of some Indian species of *Ocimum* and *Geniosporum* (Labiatae). J.R. Press & V.V. Sivarajan. 1989. Pp. 113–116, 4 figs.

Revision of *Piper* (Piperaceae) in the New World 1. Review of characters and taxonomy of *Piper* section *Macrstachys*. M.C. Tebbs. 1989. Pp. 117–158, 41 figs. **£48.00**

Volume 20

No. 1 Studies in the genus *Hypericum* L. (Guttiferae) 8. Sections 29. *Brathys* (part 2) and 30. *Trigynobrathys*. N.K.B. Robson. 1990. Pp. 1–151, 22 figs, 46 maps. **£45.00**

No. 2 The marine algal flora of Namibia: its distributions and affinities. G.W. Lawson, R.H. Simons and W.E. Isaac. 1990. Pp. 153–168, 1 fig, 7 plates.

The infragenic classification of *Gentiana* (Gentianaceae). T.-N. Ho and S.-W. Liu. 1990. Pp. 169–192, 13 figs.

Revision of *Piper* (Piperaceae) in the New World. 2. The taxonomy of *Piper* section *Churumayu*. M.C. Tebbs. 1990. Pp. 193–236, 49 figs. **£25.00**

Volume 21

No. 1 Historical and taxonomic studies in the genus *Titanoderma* (Rhodophyta, Corallinales) in the British Isles. Y.M. Chamberlain. 1991. Pp. 1–80, 247 figs.

No. 2 Early collections of the Holy Thorn (*Crataegus monogyna* cv. Biflora). A.R. Vicky. 1991. Pp. 81–83. 1 fig.

A taxonomic study of the species referred to the ascomycete genus *Leptorhaphis*. B. Aguirre-Hudson. 1991. Pp. 85–192. 76 figs.

The typification and identification of *Calymperes crassilimbatum* Renauld & Cardot (Musci: Calymperaceae). L.T. Ellis. 1991. Pp. 193–194. 1 fig.

Volume 22

No. 1 An account of southern Australian species of *Lithophyllum* (Corallinaceae, Rhodophyta). Wm. J. Woelkerling and S.J. Campbell. 1992. Pp. 1–107, 63 figs. **£37.00**

British Museum (Natural History) Publications

THE CORALLINE RED ALGAE
An analysis of the genera and subfamilies of the nongeniculate Corrallinaceae

W.J. Woelkerling

Nongeniculate coralline red algae (Corallinales, Rhodophyta) are both abundant in and vital to coral reefs, cementing the coral animal skeletons into a durable reef framework. In colder waters they form pavements of many square kilometres on the sea bed. It is one of the aims of this study to help resolve outstanding difficulties relating to taxonomy of the group. Extremely well illustrated with over 60 pages of scanning electron micrographs.

1988, 245 × 176 mm, 268 pp, 82 scanning electron micrographs, 259 figs, 19 tables.
Co-published with Oxford University Press.
0 198 54249 6 Hardback **£40.00**

TAXONOMY AND BIOGEOGRAPHY OF MACQUARIE ISLANDS SEAWEEDS

R.W. Ricker
1987, 175 × 250 mm, 344 pp, 126 figs.
0 565 00998 2 Hardback **£40.00**

SEAWEEDS OF THE BRITISH ISLES

Vol. 1. Part 1. Rhodophyta. Introduction, Nemaliales, Gigartinales. *P.S. Dixon & L.M. Irvine.*
1977, xi + 252 pp, 90 figs.
0 565 00781 5 Paperback **£15.00**

Vol. 1. Part 2A. Cryptonemiales (*sensu stricto*), Palmariales, Rhodymeniales. *L.M. Irvine.*
1983, xii + 115 pp, 28 figs.
0 565 00871 4 Paperback **£15.00**

Vol. 2. Chlorophyta. *E.M. Burrows.*
1991, 256 pp.
0 565 00981 8 Paperback **£27.00**

Vol. 3. Part 1. Fucophyceae (Phaeophyceae). *R.L. Fletcher.*
1987, 145 × 210 mm, 359 pp, 90 figs, 15 plates.
0 565 00992 3 Paperback **£30.00**

Vol. 4. Tribophyceae (Xanthophyceae). *T. Christensen.*
1987, 145 × 210 mm, 36 pp, 8 figs.
0 565 00980 X Paperback **£7.50**

CONTENTS

109 **Palynological evidence for the generic delimitation of Sechium (Cucurbitaceae) and its allies**
J.L. Alvarado, R. Lira-Saade and J. Caballero

123 **Seaweeds of the western coast of tropical Africa and adjacent islands: a critical assessment. IV. Rhodophyta (Florideae) 3. Genera H-K**
J.H. Price, D.M. John and G.W. Lawson

147 **Two new species of *Solanum* section *Geminata* (Solanaceae) from Cerro del Torrá in western Colombia**
S. Knapp

153 ***Fissidens ceylonensis* Dozy & Molkenb. (Musci = Fissidentaceae) and some allied taxa from southern India**
L.T. Ellis

157 **New species of *Piper* (Piperaceae) from Central America**
M. Tebbs

159 **Studies on the Cretan flora 1. Floristic notes**
N.J. Turland

165 **Studies on the Cretan flora 2. The *Dianthus juniperinus* complex (Caryophyllaceae)**
N.J. Turland

Bulletin British Museum (Natural History)

BOTANY SERIES

Vol. 22, No. 2, November 1992